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Mining the Air Against Zeppelins

By Carl Dienstbach

THE failure of the English high-angle anti-aircraft artillery to destroy Zeppelins attacking London has been repeatedly demonstrated, and it has stimulated many a scientific mind to invent some more efficient means of defense. At night the English aeroplanes are at a serious disadvantage, since the glare of the ground searchlights renders it almost impossible to drop bombs on the enemy with any degree of accuracy. Instead, they fall into London, causing explosion and conflagration. The same danger exists in firing upward against the almost invisible and swiftly moving Zeppelins.

Joseph Steinmetz, an American inventor, proposes to mine the air with bomb-carrying balloons! Small hydrogen balloons, connected in pairs or groups by piano wire (weighing about ten pounds to the mile) are to be set adrift when the Zeppelins are over London. According to the inventor, they would rise rapidly and enmesh the enemy's aircraft. Attached to the balloon units are small hook-trigger bombs of high explosive contact and incendiary torches, which are to be drawn into the Zeppelin's gas bag with destructive results. The method is to be further elaborated by carrying nets of very wide mesh, an idea successfully applied in submarine warfare. In the opinion of Mr. Steinmetz, even though the chance of a Zeppelin's fouling the balloon-connecting wires is only one in a thousand, that one chance is well worth the attempt and expense.

At first blush this scheme
the air as a defense agains
is attractively plausible.
if the atmosphere above
full of floating air-mines, it would not be so easy to bombard the town from aloft. When it comes to making this arrangement practical, however, serious difficulties are immediately encountered. Flotation in air is not like flotation in water. A balloon left to itself invariably goes up or comes down. It is generally considered a wonderful accomplishment if a balloonist knows the aerial ocean well enough to keep his craft in regions where sun, winds and vapors do not continually force it from its level, thus causing him to use up gas and ballast and shortening the trip. Over a great city, this procedure would be extremely hazardous. After the air has been thoroughly sown with mine-balloons, it may snow. Imagine the result! With a wind blowing the balloons about during a snow storm, and their bombs striking roofs right and left, the inhabitants of London might prefer the attacks of the Zeppelins. Think of the conflagation these clusters of balloons might cause!

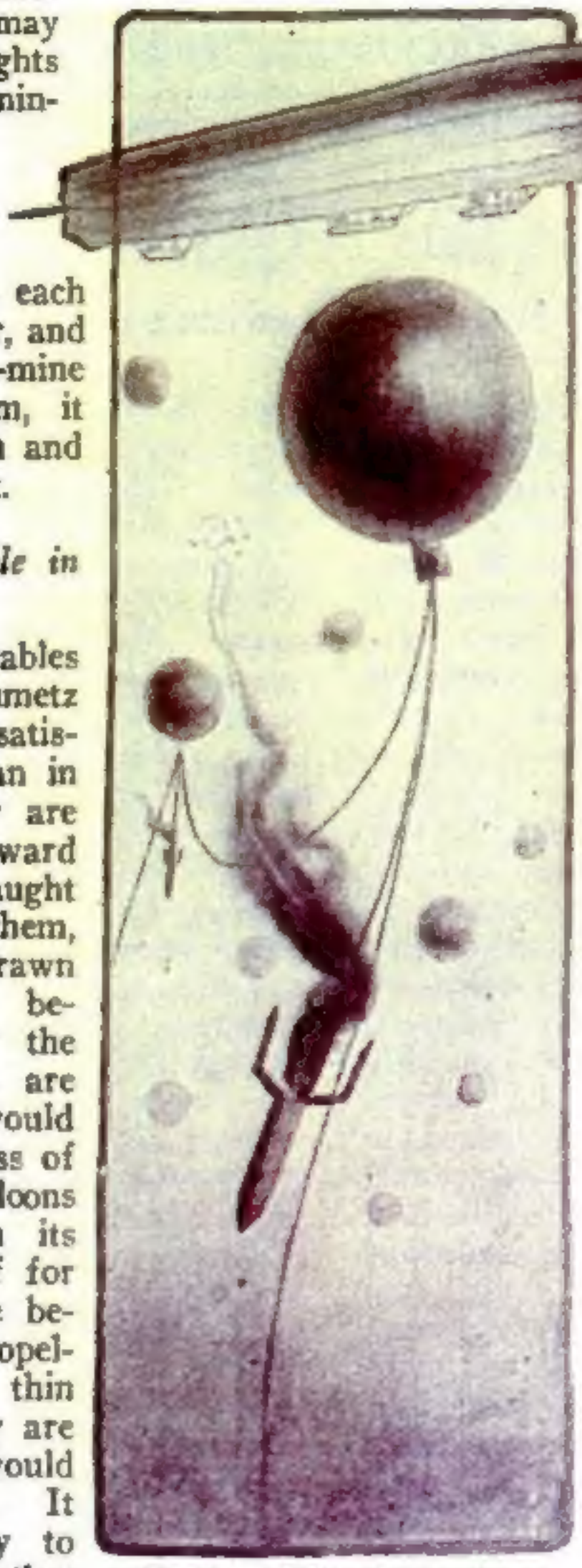
The whole plan harks back to the experiment made in Austrian campaign against Venice in 1849. Nothing was done by halves at that time. No less than two hundred small hydrogen balloons, each carrying a twenty-five or thirty pound bomb, were liberated, but they refused to stay at the right level. They continued to rise until an upper current of opposite direction found t
and returned them to the senders.

Even
mine-balloons rem

balloons must be many times larger than the heaviest floating mines. At short range they would furnish ideal targets to a Zeppelin's machine-guns. A Zeppelin may easily shade its lights and yet clearly illuminate a near object in the air. Let a good marksman with a machine-gun be stationed at each side of the front car, and before any balloon-mine could do any harm, it would be shot down and fall into a city street.

The Plan Is Feasible in Water

Interconnecting cables such as Mr. Steinmetz proposes, are more satisfactory in water than in the air, where they are liable to slip off upward or downward. If caught by airships below them, the bombs will be drawn together harmlessly beneath the level of the hull. The chances are that the Zeppelin would gather a trailing mass of wires, empty balloons and live bombs in its wake, to be cut off for the benefit of those below. The steel propellers would cut the thin wire, and since they are as big and heavy, would hardly be damaged. It would also be easy to shape a Zeppelin so that single wire must slip off wherever it strikes the hull, simply by slanting the outlines of all pro-i- ons.



Hooks and flaming bombs as a terror of the air for Zeppelins and, indeed, for any denizens of the air. But is the terror not as great for the houses below?

Sweeping a Channel for Mines

THE operation of mine sweeping is one of the most dangerous and arduous of the many tasks that fall to the lot of a navy. The dangers of mine sweeping are great even in the North Sea and around the British Coasts, where there is no active opposition. These dangers are, of course, greatly increased when the ships are continually under fire, as they were in the Dardanelles.

A mine field consists of a number of mines laid together. It will most effectively block off any particular area of water. A certain number of mines are generally laid at intervals just deep enough to render them invisible to the look-out on board the mine sweepers. For such work shallow draught ships are always employed.

Mine sweepers work generally in pairs. Each ship tows over the stern a wooden apparatus called a kite, fitted with planes which dive beneath the water. The depth to which it dives is regulated by the speed of the towing ship. Each of these kites is fitted with a pulley block. A wire rope is passed from the stern of one ship through the pulley on its own kite across the water through the block on the second kite and so up to the stern of the second ship, where it is fastened. Both ships steaming at the same speed, the kites will dive to a depth corresponding to the speed of the towing ship, and the steel rope is suspended between them. When the

does not look as though the Stein- plan would -- struc-

Cleaning New York's Snow-Clogged Streets With Motor-Trucks

Motor-trucks mobilized by city for snow removal dump their loads into Hudson River

One of the new motor-driven snow plows which did much to make the streets passable after the recent New York storm

ON Monday morning, December 13, came New York's first heavy snow storm of the winter. When business men and women started for work, the city's transportation lines were sadly disorganized. Street cars, busses and taxi-cabs floundered through the snow and took workers to their offices, hours late.

At noon, those who were hardy enough to venture out to lunch saw a novel spectacle. Great numbers of privately-owned motor-trucks were crawling through the streets laden with snow. Drawn up beside huge heaps of snow in the busiest streets were other powerful trucks, and gangs of men were speedily throwing the snow into their capacious bodies. The old-fashioned street-cleaners' wagons with their patient horses were in evidence, too, but they were a minor consideration. The great work was being accomplished by the motor trucks.

Through the avenues came heavy-powered trucks with snow-plows fastened to their front axles. Many of these were furnished by a 'buss company, while others were private trucks with a special plow attachment fitted for

the emergency. These plows pushed the snow into the middle of the streets, where it was carried away by the workers.

On Tuesday morning, nearly all of the vast quantity of snow had disappeared from the main thoroughfares, and the fleet of motor-trucks vanished as suddenly as they had appeared. Heaps of snow still clogged the middle of many of the side streets, but the work of removing this was done as it had been in previous winters, by gangs of men working twenty-four hours a day, aided by horse-drawn carts.

Where did the motor-trucks come from? Where had they gone when the main streets and avenues had been cleared?

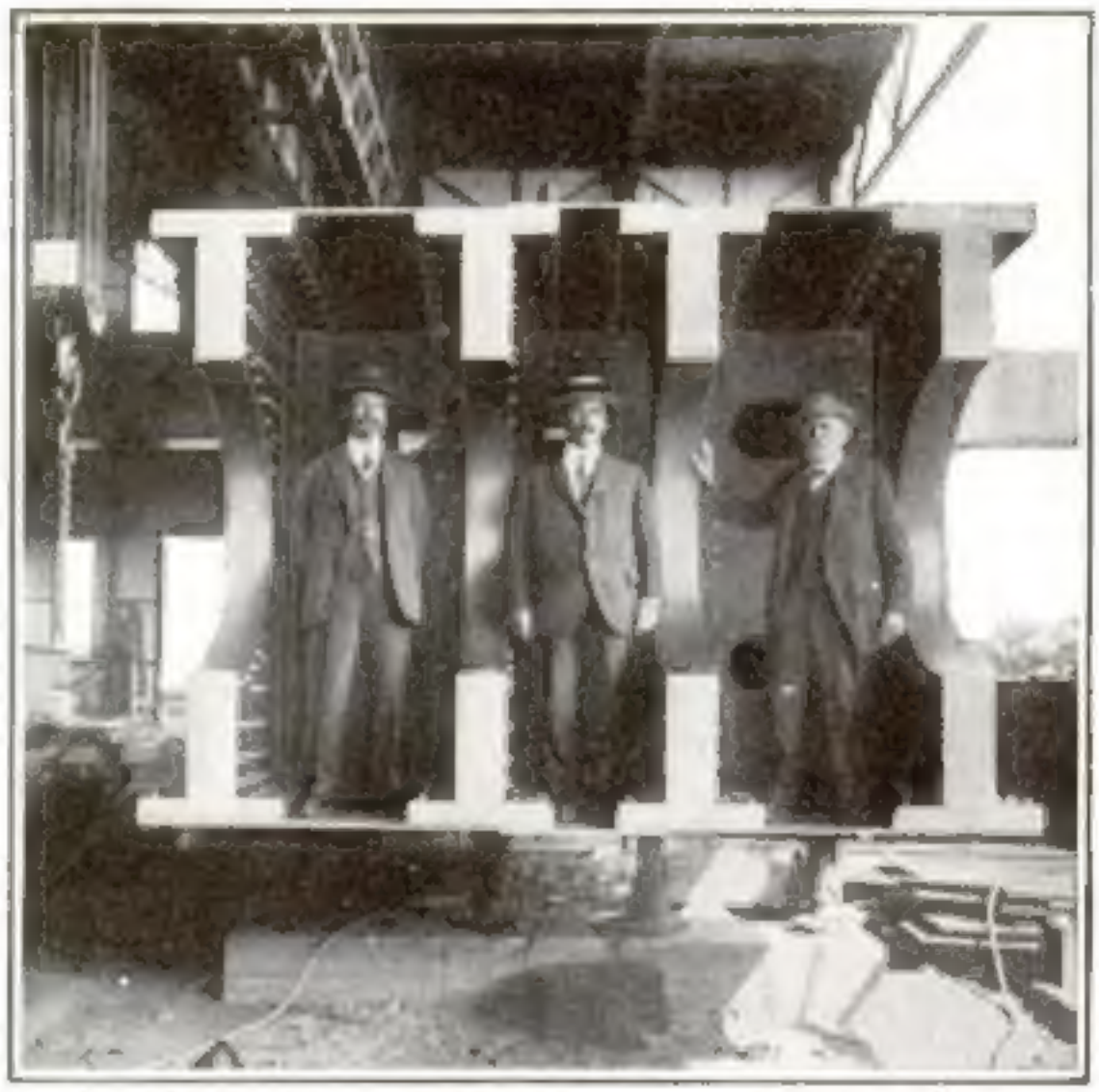
Dissatisfied with the slow methods of snow removal last winter when two or three heavy storms paralyzed the traffic of the city, Street Cleaning Commissioner Fetherstone arranged with a number of large contractors to mobilize a fleet of privately owned motor-trucks, suitable for the removal of snow, whenever a storm threatened to disorganize the transportation of the city.

A census was taken of the owners of trucks who were willing to furnish them when needed for this work. A large number of these powerful vehicles were placed at the disposal of the contractors, and when the call was sent, the trucks were quickly at their appointed stations.

The work done by these trucks was remarkable. The ample bodies held an average load of two and one-half times the amount of snow that could be contained in the largest of the old-style carts and wagons, and the snow was carried to the various disposal points in a small part of the time usually required. As a result, the snow disappeared from the important streets as if by magic.

A Gigantic Steel Bridge-Beam

ONE of the greatest of modern engineering undertakings is the construction of the New Quebec Bridge, which upon completion will span the St. Lawrence near Quebec on the site of the great Quebec Bridge which collapsed several years ago with a great loss of life. Work upon the foundations of the original bridge was begun in the early spring of 1910, but nearly all the work accomplished when the bridge fell had to be practically abandoned and recommenced from the foundations themselves.



One of the largest steel beams ever used in bridge building, designed in place of the faulty members which caused the disastrous collapse of the new bridge at Quebec, before it was completed

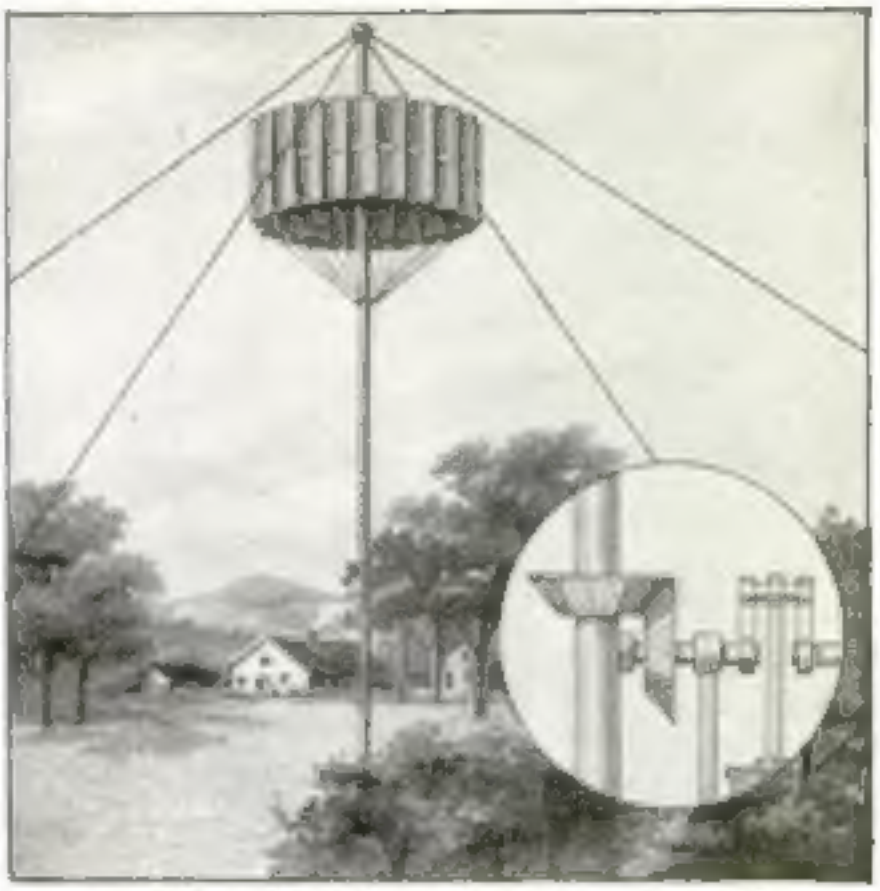
Since the disastrous collapse was caused by weak members, the engineers have fitted to the new bridge some of the largest steel beams ever used in bridge building. An idea of their great size may be gained from the illustration, showing an end section of one of the members. Half of the pin hole shown is to receive a steel pin nearly four feet in diameter. It is expected that trains will be crossing the bridge in another twelve months.

A Windmill Which Always Turns in the Same Direction

WHEN the wind strikes a surface inclined at an angle to the direction of the wind, the surface is displaced in a direction that depends upon the degree of inclination. Upon this well-known principle sailboats, windmills, and aeroplanes are built. When the wind comes in an opposite direction—that is to say, strikes the surface on the other side—it tends to displace it in the opposite direction. It would seem then to be impossible so to place a surface that it shall always move in the same direction no matter whence the wind comes. A French windmill maker, however, has succeeded in solving the problem. He makes a horizontal windmill with perpendicular vanes and axis revolved by the planes without gearing.

The vanes are formed of many sheets of iron arranged in the form of a wheel. The wind on entering the wheel passes between the plates and produces motion, and the wind on issuing, dips along the general slope of the vane and produces motion in the same direction.

The wind is thus utilized going and coming. When the vanes are properly inclined, the power produced by this strange windmill is high, and the wind that reaches nine-tenths of the wheel's diameter is set to work, no matter in what direction it is blowing.



Puzzling windmill which always turns in the same direction, no matter how the wind is blowing

An Island Made to Order

HAWAIIAN soil is being used to build up the small coral island in the Pacific Ocean known as the Midway and used as a relay station by a trans-Pacific cable company. A quantity of earth is taken there every three months by the schooner that is sent with food supplies for the operators. The task of building the island has progressed so far that it is now possible to keep a cow on the pasture.

The Longest Letter in the World

YOUR friends are always asking for long letters. To supply this demand a man in Los Angeles, California, has invented a little novelty that has captured the fancy of visiting tourists.

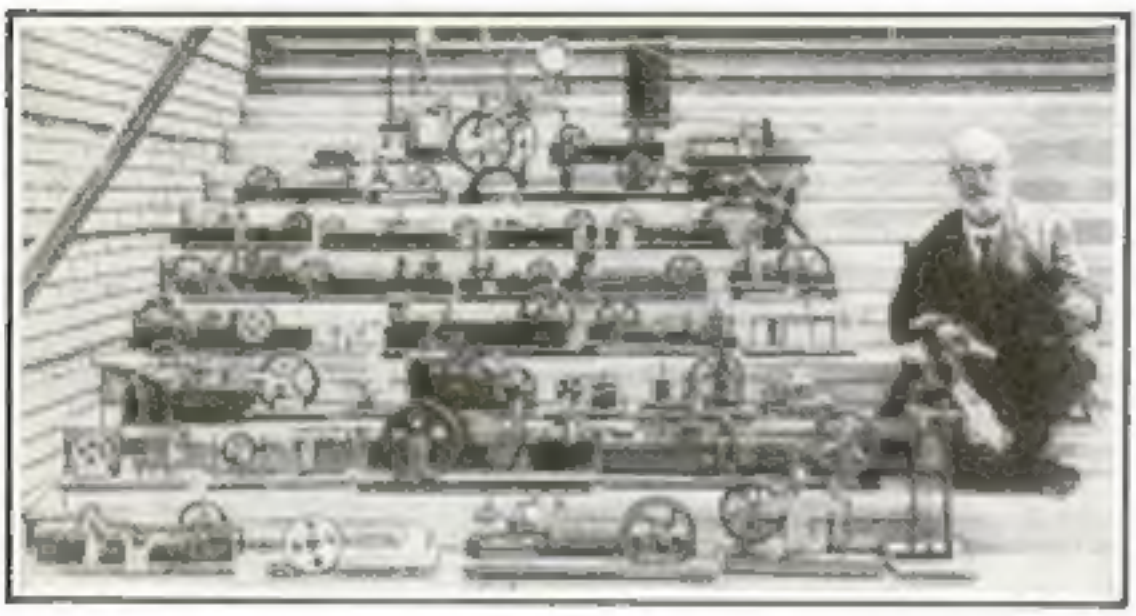
It consists of a roll of paper tape sixty feet long. The paper is made to write on, and has a place for the name and address of the sender and receiver. It goes as first class mail for two cents, like any other letter, and can be mailed in any mail box.

These little "long letters" cause many a laugh and one can write a regular letter on the tape, by merely unrolling it as it is used up.

The roll of tape is sixty feet long. On it is written one of the longest letters ever mailed for two cents

Steam-Driven Models Made by a Handless Mechanic

ONE of the chief exhibits at the Home for Aged and Disabled Railroad Employees of America, Highland Falls, Ill., is a collection of model steam engines made by handless Joseph J. Bellaire.



All these miniature engines are driven by steam or air, and were made by the "handless mechanic"

Thirty-four years ago Mr. Bellaire, a young and healthy locomotive fireman, swung down from his cab and crawled under his engine to take the ashes from the firebox. The engineer, forgetting that his mate was beneath the wheels, received the signal from the brakeman and set his engine in motion. The unfortunate fireman, hearing the creak of the wheels, made a wild plunge for safety, and succeeded in freeing himself—all but his hands. When they took him to the hospital they saved one thumb on his right hand.

With infinite patience Mr. Bellaire succeeded in making his artificial hands useful. On his right hand is a thumb and a metal plate. On the left wrist is strapped a wooden attachment, in the center of which is a threaded hole for the insertion of various handy devices, the most useful of which is a steel hook.

Since his accident he has spent much of the time in constructing models of engines, some of which are remarkable bits of machinery. Working models of steam engines predominate in his collections, and most of them run on steam or compressed air. The various tubes and cylinders are soldered together instead of being riveted. All the models work like clockwork. Mr. Bellaire has exhibited his models many times and has received a large number of prizes and medals.

Tearing Up Rails with a Motor Truck

PULLING up the half-buried track of an old railroad much in the same way as a dentist extracts an obstinate tooth, is the novel use to which a heavy motor truck, armed with a derrick, was recently put in a small Ohio town. The boom of the derrick was secured by a heavy braced pillar, which acted as a pivot, to the floor of the truck. Tongs were used to clutch the rail, and the pull exerted through a steel cable and pulleys. This wrecking equipment "extracted" between one hundred and sixty and one hundred and seventy rails per day, which is equivalent to a length of track a half-mile long.

This truck pulls up a half-mile of track during a working day

A Motor-Cycle Converted into a Motor-Sled

HOW to make a power sled, is a problem that has been solved in a rough way at least, by C. H. Carpenter of Waukesha, Wis., whose great plaint in life has been that the motor-cycle he so dearly loves to tour with in summer, with his family, is not available for use in the winter, when the frost is on the pumpkin and the snow upon the ground.

This motor-sled was converted from a motor-cycle at total expense of about one dollar

He has solved the problem, he believes, and that with a total expense of fifty cents for a packing box and about as much for nails and screws. An iron framework, blacksmithed to hold the motor-cycle firmly to the rest of the machine, added the greatest item of cost; for with felt lined clamps to grip, yet not mar the enamel of the motor-cycle, the iron work cost the sum of two dollars.

Mr. Carpenter has made a motor-sled, with a packing box, his motor-cycle, and the stout, hickory runners of an old coasting sled, cut for the purpose. Taking sections of two coasting sleds, the framework of iron was so designed that the motor-cycle power wheel operated between the sleds, much as the walking beam of an old-fashioned steamboat works on the shaft of the paddle-wheels. Built upon the sled, the packing box was cut down, planed and painted. It was given a high back, and the portion cut away in front was converted into a seat. The sled makes about twelve miles an hour, the motor-cycle being equipped on the power wheel with a special gripping tire, made by the simple method of winding wire about the tire and rim.

Electric Candles on a Nine-Story Birthday Cake

A BIG birthday cake, with thirty-five electric candles on the top, is a sight which recently astonished Columbus, Ohio. The cake was made in recognition of the thirty-fifth birthday anniversay of a large store devoted to the sale of women's goods. Heretofore it had been the custom to make use of the traditional wax candles but for obvious reasons it was decided this year to make the experiment of using electric candles, which would last longer, give more light and be much more cleanly than those of wax.

The result of the experiment was wholly satisfactory and electric candles will be used in the future. The wiring was buried in the sugar covering of the cake.

Apart from this novel electrical feature the cake itself was very interesting because it was one of the largest ever baked in this country. It was a nine-story layer cake weighing a little short of a ton and it required the services of eight men to carry it from the motor truck which hauled it around the city into the store, where it was the center of attraction. It was four and one-half feet in diameter and into its composition there entered a barrel of flour and one thousand eggs, three tubs of butter, fifty quarts of milk, one quart of lemon flavoring, one quart of vanilla flavoring. It was covered with two hundred and twenty-five pounds of icing.

This cake would supply every employee of the store with a generous portion.

Thirty-five electric candles graced this one-ton birthday cake, which required eight men and a motor-truck to deliver it from the bakery

A Boy's Street Boat

ECHOING the spirit of his forefathers who crossed the bleak prairies of the west in the days of the California gold rush, when sails were occasionally raised on the prairie schooners to help the horses along, a New York boy has added a leg o' mutton sail to the foot power driving equipment of his "scooter" with the result that he has been several times in danger of breaking the speed laws of his city.

With front and rear wheels oiled well,

With the aid of a brisk breeze, this scooter can break the city's speed laws

and a brisk breeze blowing, he can travel at a twenty-mile-an-hour clip without much difficulty, despite the crude construction of his vehicle. The front wheels are those of a discarded baby carriage, while those in the rear are rollers taken from skates. The name of this conveyance is the "windmobile," which is at least as happy as the names of apartment houses and Pullman cars.

Bread Without Grain Flour

CHEMISTRY in Germany is struggling to produce a substitute for grain flour in making a palatable and nourishing bread. The recent potato harvest being large, most research-workers have sought to use flour from grain in place of potato starch. The difficulty is that when bread contains an unusual proportion of potato starch, or even of rice or tapioca starch, it lacks the sponginess produced in ordinary bread through the carbonic acid developed by the fermentation of yeast or by baking powder.

In an article on the subject in *Umschau* some account is given of the experiments made to overcome the objections to the use of grain flour substituted. It had been proved that the defect in pure starch flour for bread-making is the lack of gluten, for the elasticity and toughness of ordinary dough are caused by the albumen contained in gluten. A chemist named Fornet claims to have found a substance which, when mixed with dough from starch flour, produces the physical characteristics of gluten. The dough is raised with yeast, can be made from all kinds of starch, and looks like ordinary white bread. The bread has been found edible at the army front when several days old. The substance discovered is not yet announced. The famous chemist, Wilhelm Ostwald, has proved that the albumen of gluten is coagulated by heat during baking and has used egg albumen instead with or without a gas-producer, as yeast or baking powder, with good results, but the process is too costly. Walter Ostwald and A. Riedel have substituted thick starch pastes for the various albumens in the dough. These pastes resemble gluten in the qualities of elasticity and impermeability to gas and are also cheap. The leaven is made of potato flour, milk, and pressed hops; baking powder can also be used. The inner friction of the starch paste produces in baking the necessary puffiness and porosity of the dough, and the loaf shows an elastic, porous crumb of fairly normal thickness.

Wilhelm Ostwald also substituted casein dissolved in ammonium carbonate for gluten. In baking, the ammonia and carbonic gases present acted as leaven while the casein replaced the gluten of ordinary white flour.

Enlisted Men: The Foundation of the American Navy

By Josephus Daniels, Secretary of the Navy

Loading a four-inch gun in battle practice on the cleared deck of a torpedo boat

Josephus Daniels

ONE of the curious and unexpected things which I have found since I assumed the duties of Secretary of the Navy has been the effect of a too near point of view in destroying the perspective of some of our ablest Naval Officers as to what the subordination of everything connected with the Navy to its military functions really means, and how far back military preparation must begin.

As each new civilian Secretary of the Navy assumes office, it has of ancient custom been regarded by the service as necessary for the Naval officers with whom he comes in immediate contact in the Department to impress upon him that the Navy is a fighting machine, that its sole purpose and reason for existence is to fight and fight effectively, and that everything that is done must be done with this foundation principle constantly in mind. This is an almost self-evident truth, and it would be indeed a dull mind that could not grasp it and agree, but in the carrying out of this principle there is, I find, a tendency to begin at the top, and, working down towards the foundation of things, to stop suddenly before the bottom is

reached. Thus, in all matters of discipline aboard ship.

Thus, in matters of discipline aboard ship, in the training of crews and squadrons, in maneuvers and strategy, in armament and equipment, the idea of military efficiency has been splendidly carried out, and in these matters I hold our Navy ranks second to none.

Have Our Officers Lost Perspective?

When it comes, however, to the utilization of our yards so that they will be of the greatest aid to the Navy as a military weapon, to the subordination of all our so-called civilian activities in the Department to the great military plan, and to the recruiting of men who will prove the most efficient military units, worthy of promotion, when fit, even to flag rank, many of our high navy officers have lost their perspective. This is all the more curious because the German military organization is continually held up by these naval officers as the ideal to be achieved, and if there is any one feature where the German differs from other organizations it is in the thoroughness with which the beginnings of things and things ordinarily thought of as particularly civil are bent and subordinated from the start to their place in the final military organization.

The need of perfectly trained crews so high in character and intelligence that they can grasp the most intricate matters of machinery and drill, that they can save tenths of seconds in the firing of a gun or keep in constant repair the most delicate electrical machinery, is recognized by navy officers as highly important, but there were many, until very recently, who considered that no special effort was required to attract to the service the class of men from whom these results can be obtained. Possibly this was because, in Germany, for instance, military service is compulsory, and the men with the brains and intelligence needed are compelled to enter some military arm of the service in any event, whereas in this country, depending as we do upon voluntary enlistments, high class men cannot be secured unless there are real inducements far more attractive than pretty pictures on recruiting billboards.

It was to remedy this failure to begin at the bottom in one of the most important military matters which led me to inaugurate new ways to attract the right class of men to the service and to keep them in the service when once so attracted by making the term of enlistment a great opportunity to obtain, at Government expense, an education, particularly along technical lines, which would enable the man, upon his discharge, to obtain a higher wage.

Opportunities for such improvement existed before I became Secretary, and, while they have been considerably enlarged since then, the only sweeping change has been to give to those enlisted men who lacked it the rudimentary school education needed before they could comprehend the mechanical and electrical trades.

What I have done, however, is to bring prominently before the country on every occasion the fact that such opportunities existed, and I believe there is hardly a young man anxious to improve himself who does not know that in the Navy he can find his opportunity.

Our Recruits the Cream of Youth

The result of this campaign has been gratifying in the extreme, and the Navy is now recruited to its full strength from so many applicants that we are able to pick the very cream, our latest figures showing that only *seventeen* per cent of those who apply are now accepted. In addition, while the value of a man who has already had the training of one enlistment term in the Navy is recognized as being far greater than that of a landsman just taken on board, and while the military importance of having men of long experience on every ship has been acknowledged, the equal importance of making the service attractive to the enlisted men in order to keep them in the service has not been sufficiently considered until recently. Without abating one jot of the rigid military discipline, without pampering or favoring the enlisted man at the risk of destroying his efficiency as a cog in a great machine, the number of re-enlistments has increased, as the result, from fifty-four per cent to

The daily drill on the ship's deck is an important and interesting feature of the day's routine. Above, sailors in a battle ship reading-room

turing establishments as worth time and money in increased efficiency of workmen

The young man who has mastered the fundamentals of some particular trade can enlist in the Navy and be assigned immediately to work at that trade with sure promotion ahead of him. The experience that he gets in the Navy will be far broader and greater in

The navy turns out good stenographers and typewriters as well as good mechanics

ninety-two per cent

I am asking Congress this year for eleven thousand five hundred more men for our Navy. Thanks to the policy outlined, there is not the slightest doubt that we will be able to get eleven thousand five hundred (or more when they are needed) young men of the highest type, keen, intelligent, desirous of improving, and willing to learn their duties. It has simply been a case of willingness to learn from civil life the most efficient way to achieve a military object, for the education of apprentices has been recognized by great manufac- all probability than he would get working at his trade outside. Take the young man who has gone in for electricity and who lives in a small town. He has few chances of learning the higher branches of his profession; wiring for electric

bells, occasionally repairing a small motor, putting in electric light fixtures these are practically the limits of his experience. On every battleship, however, are to be found the most delicate and complicated of electrical apparatus, huge dynamos of enormous horsepower, delicate signaling and recording instruments; every kind of electrical apparatus is there. How to make and how to repair this apparatus is a part of his military education, progressing from the simpler work to that requiring the greatest skill, and with this training will go a thorough education in the fundamental principles of electricity as well

Every Recruit is Trained to Become a Skilled Artisan

When he leaves the service he will be too proficient as an electrical expert to be in any danger of being compelled to spend the rest of his days as he began —putting up bell wires or installing electric lights in a small town. He will be a welcome addition to any of the great electrical and manufacturing establishments, with good wages, and perhaps a place at the very top.

This is true of all the other vocations, and fifty of them are taught in the Navy There has just been established, for instance, a new class at Charleston for instruction in gasoline engines, where the enlisted men will be taught not only the theory but the practical handling of the largest gasoline engines now in use. Machinery of all kinds is used in these schools for enlisted men, and, in addition, what is known as the yeoman branch affords an opportunity for those who desire to become expert stenographers, typewriters and accountants. Here is a partial list of the schools for enlisted men at present maintained by the Navy. It is interesting as showing the wide range of subjects covered.

1. Navy aviation school.
   Pensacola, Fla.
2. Electrical schools.
   Navy Yard, New York;
   Navy Yard, Mare Island.
3. Artificers' school
   Navy Yard, Norfolk.
4. Oil burning school.
   Navy Yard, Philadelphia.
5. Machinist's mates' school and school for gas engines.
   Charleston, S. C.
6. Seaman gunner school and school for diving.
   Naval Torpedo Station, Newport, R. I.
7. Yeoman schools.
   Newport, R. I.,
   San Francisco, Cal.
8. Musicians' school.
   San Francisco, Cal.
   Norfolk, Va.
9. Hospital training schools,
   Newport, R. I.,
   San Francisco, Cal.
10. Commissary school (for ship's cooks, bakers and commissary stewards),
    San Francisco, Cal.,
    Newport, R. I.
11. Mess attendants' school,
    Norfolk, Va.
12. Naval Training Stations for apprentice seamen,
    Newport, R. I.
    Norfolk, Va
    Great Lakes, Ill.
    San Francisco, Cal.

How thorough the instruction is, can best be shown by the course of instruction in the Navy Electrical School at the New York Navy Yard, which follows.

During the first week of instruction, the recruit studies machine shop work, such as forging, welding, tempering, annealing, brazing and soldering, and thread cutting.

In the second week, his machine shop instruction continues, the novice becoming familiar with the hand operated tools such as the lathe and lathe tools, the shaper and shaper tools, the drill press, the milling machine and mill-cutters, and the emery wheel. He also learns the rudiments of machine shop work, such as bench, lathe, drill press, milling machine and emery wheel work.

For the third week, he studies reciprocating steam engines, the various courses being in simple and compound reciprocating engines, also in the auxiliaries, viz., separators, traps, pressure regulators, all kinds of valves, condensers, pumps, gages, revolution counters, tachometers and indicators. Practical operation of engines and practical work also occupy much of his time. He learns assembling and dissembling engines, lining up engines, resetting and adjusting valves, reading indicators, overhauling and repairing engine and pumps and the regrinding of valves.

The subject of steam turbines is taught during the fourth week. The

practical operation and care and preservation of these complicated engines keeps the recruit busy during the week.

For the fifth week, the subject is that of internal combustion engines. The study of the principles of these engines, and of special types such as the Hornsby-Akroyd, Metz and Weiss oil engines, is

Bluejackets in artillery and infantry exercises ashore. Above, a schoolroom on shipboard

The navy offers an opportunity to study electrical engineering

thoroughly pursued, and the practical operation, care and preservation of all oil engines is taught

In the sixth week, the theory of magnetism and electricity is studied, and in the seventh week, the instructors teach the students the theory of the dynamo and electro-magnetism

Practical work on dynamos is accomplished during the next two weeks, and pupils learn the mysteries of turbo generators, switch boards, operating dynamos in parallel, care of the plant and dynamo room routine

Theoretical and practical work on motors occupy the recruits' time from the tenth to the twelfth week. Studies are made of the principles of direct current motors, motor generators and dynamos, and practical work is done on service motors and motor starting and controlling devices. Ammunition conveyors and hoists, gun elevating

equipments, rammers and turret turning equipments are made the subject of study.

The thirteenth, fourteenth and fifteenth weeks are devoted to the study of the theory and practice of lighting and interior communication. The subjects listed are instruments, circuits and fuses, incandescent and arc lights, telephones, wires and wiring, wiring appliances and fixtures, search lights, signaling apparatus, interior communication cables, switchboards, telephone circuits, telephones and fire controls.

During the sixteenth and seventeenth weeks the theory and practice of primary and secondary batteries are studied.

The last two weeks, the eighteenth and nineteenth, are spent in a general review of the entire course, and any points that have been missed by the pupils are made clear in their minds.

Radio Telegraphy

For the first six weeks of the course in radio or wireless telegraphy, the study closely parallels the study of magnetism and electricity, dynamos and motors, alternating currents, batteries, and internal combustions which is pursued in the course just outlined.

From the seventh to the nineteenth weeks, the pupil is constantly practicing at the instrument, becoming efficient at sending and receiving. He also devotes one week each to the following subjects: Condensers, inductances, oscillating currents, primary circuits (transmitting), secondary circuits and closed oscillating circuits, radiating circuits, transmitting sets, receiving apparatus, receiving circuits, Fessenden sets, wireless specialty companies' sets, and Telefunken sets The nineteenth week is spent in review, as in the other course.

Immediate entrance to these schools is, of course, obtained only by those who already have some knowledge of the trade, but every enlisted man who wants to take up a trade of which he may be utterly ignorant at the time of his enlistment has only himself to blame if he does not eventually acquire a chance to obtain this special shore instruction He has only to state to his superiors on the ship what line he would like to follow and provided there are not too many already having the same desire at the time on the ship, he will be assigned duties on shipboard which will give him a certain familiarity with the subject. After a year's service, he can make application for a special course of training at the school, and, if he has shown sufficient intelligence and progress in his work on board ship, he is certain to have his request granted.

With such inducements and with a daily school on shipboard where the subjects to be found in every public school on shore are taught him as well, it is not surprising that, instead of a lack of men of the type desired, the Navy now finds it a difficult matter to choose from the host of applicants those best suited for the service. Judges no longer sentence ne'er-do-wells to the Navy as a punishment, nor are such men received, and desertions in the last three years have decreased thirty-two per cent.

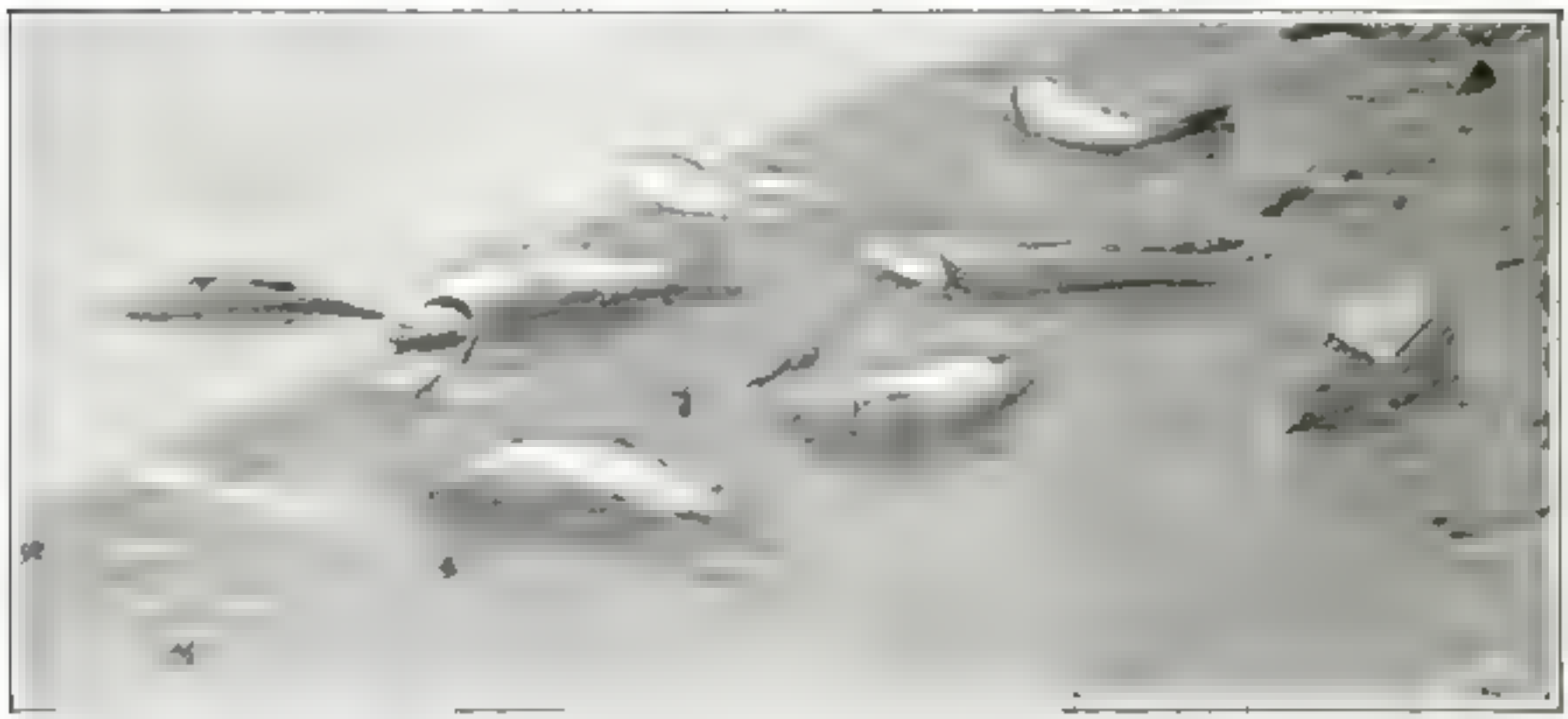
In this way has the doctrine of subordination of everything to military efficiency been carried to the very beginning, and we are certain of efficient crews on board our ships because we have efficient recruits to begin with.

Iron Industry Gains in Germany.

DESPITE the smothering effects that the war has upon industry of all kinds, the production and manufacture of iron implements increased considerably in Germany since the opening of hostilities. During the last year of peace, 1913, the German iron industry mined approximately 35,941,000 tons of domestic iron ore, from which, after exporting 2,613,000 tons and importing 14,019,000 tons, a total of 19,300,000 tons of crude iron was smelted. During the month of August, 1914, when the war started, the output of iron products sank to 18,310 tons daily. During 1915 this daily average has increased to 33,000 tons. A large percentage of the iron being produced in Germany is finding its way into war implements of various sorts.

THE commission form of government is in effect in eighty-one of the two hundred and four cities in this country of over thirty thousand inhabitants.

Fish That Travel on Land



When the tide goes out and strands these fish in a shallow pool, they leave the water, and actually flop over land to the sea. They never get lost and travel in the wrong direction, but always take the straightest road back to deep water

SCIENTISTS rarely go a-fishing in troubled waters; Professor S. O. Mast, however, of the zoological department of Johns Hopkins, is an exception. The Johns Hopkins professor discovered that such fish as minnows are often found in the little temporary pools left in the sand by the tide, but rarely, if ever, after the water in such a tide is so low that the outlet is closed.

When the tide is falling, these fish—*fundulus majalisis*, the scientific name for them—swim out, somehow knowing when the tide is about to get so low that they might be trapped in the little pools in the sand. As the tide falls, they swim in and out of such tide-pools at short intervals. Thus, these fish avoid being trapped in the pools and killed when the little collections of water dry during low tide.

Professor Mast has observed that the outlets of such tiny pools may be closed while the tide rises, but if they should close while the tide is falling, the fish swim about rapidly in various directions to discover water. If they find none, they leave the water and actually flop over land to the sea. Professor Mast has seen scores and scores of these fish leave large pools and travel across sandbars more than twelve feet wide and half a foot high. The fish nearly always leave the pools on the side towards the sea. They evidently remember the direction of the outlet and the direction from which they entered.

Curiously enough, they never make any mistakes in "walking" on dry land, either. Professor Mast never found one to take a wrong direction for any great distance. Although he admits that it is not yet definitely known how fish are guided in the right direction, it is certain that light reflected from the water is not a factor in this sense of direction.

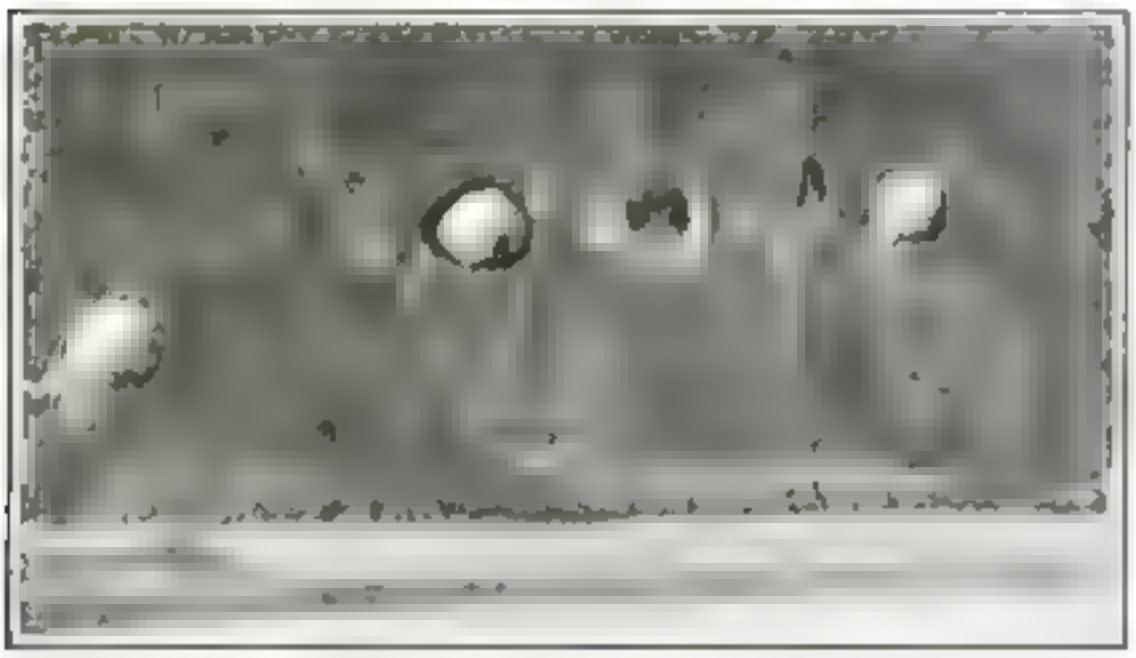
Perhaps one of the most interesting discoveries made by the Johns Hopkins zoologist shows how fish can make their way on dry land.

Of course, locomotion on land by fish can be brought about only by successive leaps and jumps produced by rapid bending and wriggling of the body or sideswiping by the tail.

When trapped in a pool which rapidly dries up or evaporates, they swim about for a few minutes, then come closely to the edge of the water and swim up and down the side of the pool nearest to the sea. Finally a dense aggregation of fish forms in the outlet near the dam, and three minutes by the watch after they are shut in, they manage to climb out on the sand. They leave in groups of twelve and "march" like General Sherman to the sea. These fish are superior to some men in finding their way home.

Natural Cannonballs

THE cannon balls illustrated are simply big, nearly spherical rocks which are found at intervals in the soft sandstone of Southern California, the same sand formation in which the great deposits of petroleum are found. Of course there is no oil left in these cliffs; it has all leached out and evaporated, but where the strata dip down from two thousand to three thousand feet below the surface, there it is saturated with oil and natural gas, to constitute one of the greatest oil deposits in the world.



Natural cannon balls found in the soft sandstone of Southern California

The Devil's Post Pile

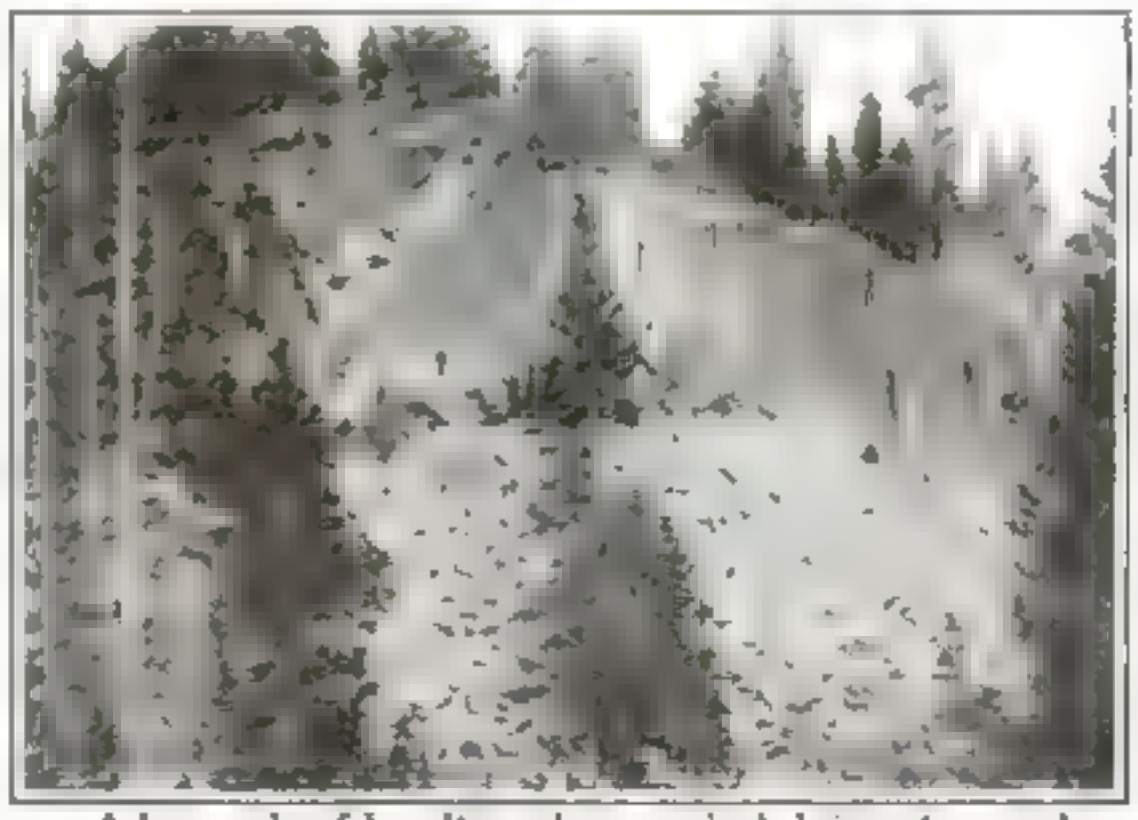
THE Devil's Post Pile is one of the greatest wonders of America. It is such a remarkable formation of volcanic rocks that it has been constituted by Presidential Proclamation into a National Monument.

The huge pile is composed of large basaltic columns about the dimensions of telegraph or telephone poles, though most of them are either hexagonal or five-sided. Some, however, are four-sided and closely resemble hewn timbers about two feet in diameter. The "posts" stand in the pile at all angles from vertical to almost horizontal.

The visible height of the tallest post is over fifty feet, although it is not known how far down they extend —a considerable distance it is believed by geologists. Each year's freezes and thaws throw down portions of the outer columns. From the vastness of the rock pile at the base of the standing columns it is evident that this process of disintegration has been going on for many centuries. The posts are composed of basalt of great hardness and density, the product of volcanic eruption. Exposed portions of the top of the pile show the scratching of glaciers, yet the pile itself and the surrounding country is covered with a layer of pumice dust, an evidence that the "post-pile" is the product of a volcanic eruption which occurred after the glaciers had long since retreated.

Fossil Plants Twenty Million Years Old

GEOLOGISTS describe what is known as the Denver Basis as a great, low, swampy region (Denver is approximately its center) which existed during an early period of the earth's history when the Rocky Mountains were just pushing their way up out of the primal ocean. This great "basin" was made up of shallow lagoons and low-lying, sandy shores on which grew a rank, tropical vegetation somewhat sim-



A huge pile of basaltic columns which brings to mind Ireland's "Giant's Causeway"

ilar to that of the valley of the Amazon today. Huge palms, fig trees and giant ferns were laced together with a tangle of vines, through which man, had he been on the earth at that time, would surely have found it difficult to pursue or escape from his enemies. And of the latter there would have been many. The country must have fairly swarmed with strange animal life, according to the bones of scores of species of the enormous, half-animal, half-reptile of the Mesozoic Era.

The photograph shows the perfectly preserved leaves and stalks of this swamp growth, which was submerged in the sandy shores of some lagoon The air having been excluded, the growth was silicified and fossilized. At a glance it resembles the intricate carving in coarse sandstone such as might have been used in some ancient decoration This formation is placed by geologists as belonging to the Cretaceous Period which is variously estimated to have been from fifteen to twenty millions years ago.

Perfectly formed leaves and twigs fossilized in the course of twenty million years

A Piece of Salt that Weighs Two Hundred Tons

AT the famous salt mines of Wieliczka, eight miles southeast of Cracow, Galacia, which was the scene of bloody fighting between the Russians and the Austrians, there recently fell a huge mass of salt weighing some two hundred tons. The great block evidently became detached from the roof of one of the chambers and came crashing to the ground. In its fall it demolished a portion of a

A two hundred ton rock of salt which recently fell into the working chamber of the greatest salt mine in Austria

passage and broke down heavy timbered barriers. No one was hurt, however

These salt mines are famous not so much on account of their size and large output as for the many wonders they contain. Indeed, they are regarded as one of the show places of Europe. They comprise a sort of underground world, with all kinds of chambers, such as ballrooms, restaurants, theatres, churches, chapels and monuments hewn out of the solid rock salt. In these chambers may be seen wonderful chandeliers carved out of the rock salt. There are sixteen subterranean lakes in the mines, on one of which is a boat. It lies some seven hundred feet below the surface of the earth. The aggregate length of the galleries at present accessible is upwards of sixty five miles and that of mining railways twenty-two miles. The mines have an annual output of no less than sixty-five thousand tons. They are the property of the Austrian government and have now been worked for upwards of a thousand years.

Niagara on Tap

By Professor Thomas H. Norton

To what extent should Niagara Falls be sacrificed in the production of electric power? Each year witnesses a growing bitterness between two factions: The one insists that no scenic treasure shall be permanently marred by servitude to the demands of commercialism; the other claims with almost relentless logic, that in the case of Niagara, the right of the nation to utilize the enormous power available, shall not be subordinated to a mere sentiment. Professor Thomas H. Norton, in a paper which he read before the American Electrochemical Society, outlined a scheme whereby it would be possible to satisfy those who see only the beauty of Niagara, and those who see only power going to waste. The following article by Professor Norton is an abstract from the paper in question, especially revised for this issue of the POPULAR SCIENCE MONTHLY *by its author.*- Editor.

THERE must be some practicable, workable thesis, according to the terms of which, on our own continent for example, the rights of its inhabitants shall suffer no material diminution in the opportunity to fully enjoy the splendor of Niagara, while conditions are created which permit the utilization, on a satisfactory scale, of the tremendous source of power,—one of the nation's grandest assets.

The principle of an *intermittent waterfall* would appear to offer a simple, but thoroughly practicable solution. It may be briefly formulated as follows:

During somewhat more than half of the twenty-four hours, especially during the night time, a waterfall is completely harnessed. Every kilowatt which it is capable of creating is devoted to the service of industry. During a shorter period—from ten A. M. to eight P. M.—the cataract resumes its normal activity, contributing to the esthetic enjoyment of all who behold it.

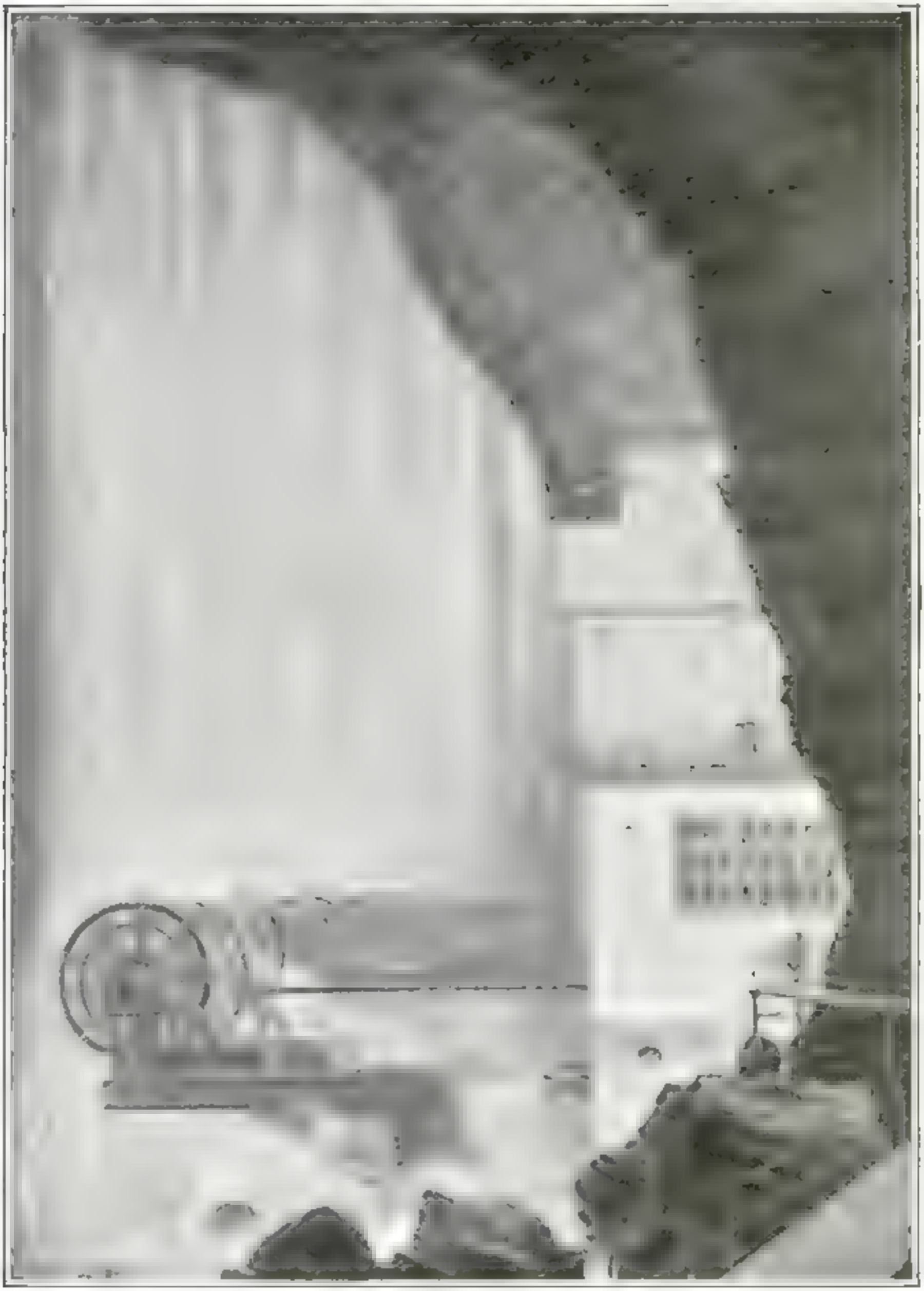
In the case of Niagara, naturally the most familiar of the world's great cataracts to the readers of the POPULAR SCIENCE MONTHLY, the application of the intermittent principle would offer no difficulties of an engineering nature. The topographic factors are simple.

To harness completely the great mass of descending water is a matter of comparative ease. The expense would be far less than that required for the monumental Assouan Dam of the river Nile,—five hundred millions. It would probably not exceed two hundred millions at the outside

One-quarter of a mile above the western extremity of Goat Island, where ripples betray the beginning of the upper rapids, a dam would be constructed at right angles to the axis of the river. The length would be about four-fifths of a mile. Niagara River at this point is exceedingly shallow. Equidistant soundings from the American shore to the Canadian shore show an average depth of 3¾ feet. It is evident that the construction, based upon the rocky bed of the river, would be relatively easy and inexpensive.

The dam would possess the necessary architectural features to harmonize with the environment. The water impounded by the closing of the gates could be led by huge canals, on both sides of the gorge, to the edge of the bluff overlooking Lake Ontario. From this point a multitude of penstocks and rock tunnels would conduct the entire volume of water to the level of the river near Queenston on the Canadian side and Lewiston on the American side, where battalions of power-houses can easily be located

The total section of the system of canals and penstocks required for the complete utilization of the average flow of Niagara River would be approximately sixteen thousand square feet. The mean flow of water, with a hydrostatic head of nearly three hundred and fifteen feet,



"In the deep recesses behind the falling sheet of water at Niagara," says Prof Norton in his article, "a gigantic system of scaffolds would be erected. These would serve as the supports of a series of over-shot wheels or endless-chain bucket wheels. By careful disposition a considerable fraction of the available power—possibly thirty to forty per cent.—could be utilized without revealing any portion of the mechanism to the eye of the beholder"

would produce about seven million, four hundred thousand horse-power.

Once provided with the mechanical means to control the vast volume of water, ordinarily sweeping over the crest of Niagara, the daily program would be as follows:

At 8 P. M. the entire series of gates on the dam would simultaneously close. A few minutes later and the American Falls would falter. The volume of water would swiftly diminish. Soon the grand curtain would be rent and gashed as if by invisible knives. A minute or two more, and rivulets here and there pour over the brink. The gloomy, cavernous recesses beneath the overhanging edge are revealed to the eye. Another minute, and the rivulets have changed to drops.

From Goat Island to the apex of the great Horseshoe the same sequence of transformations begins. It creeps steadily along the crest until it reaches the Canadian shore. The deafening roar of the cataract sinks to an agonizing groan, a reproachful sigh, a dying murmur. Niagara is silent!

A few minutes later and the rage and fury of the long stretch of rapids in the picturesque gorge falter and slowly subside. The vast volume of water between the foot of the falls and Queenston gradually drains away. A quiet lake remains between the railroad bridges and the base of the falls. Its surface is about eighty-six feet below the normal level, and the enclosing cliffs gain that much in height. It would be somewhat narrower than the present river, and frequent rocky islands would appear near the temporary banks.

For three-quarters of a mile the relatively narrow and shallow bed of the whirlpool rapids would be laid bare. The whirlpool itself would remain a somewhat restricted and motionless sheet of water, forty feet below its normal level, at the head of a quiet fjord, extending inland from Lake Ontario.

Such would be the topographic changes attending the harnessing of the cataract.

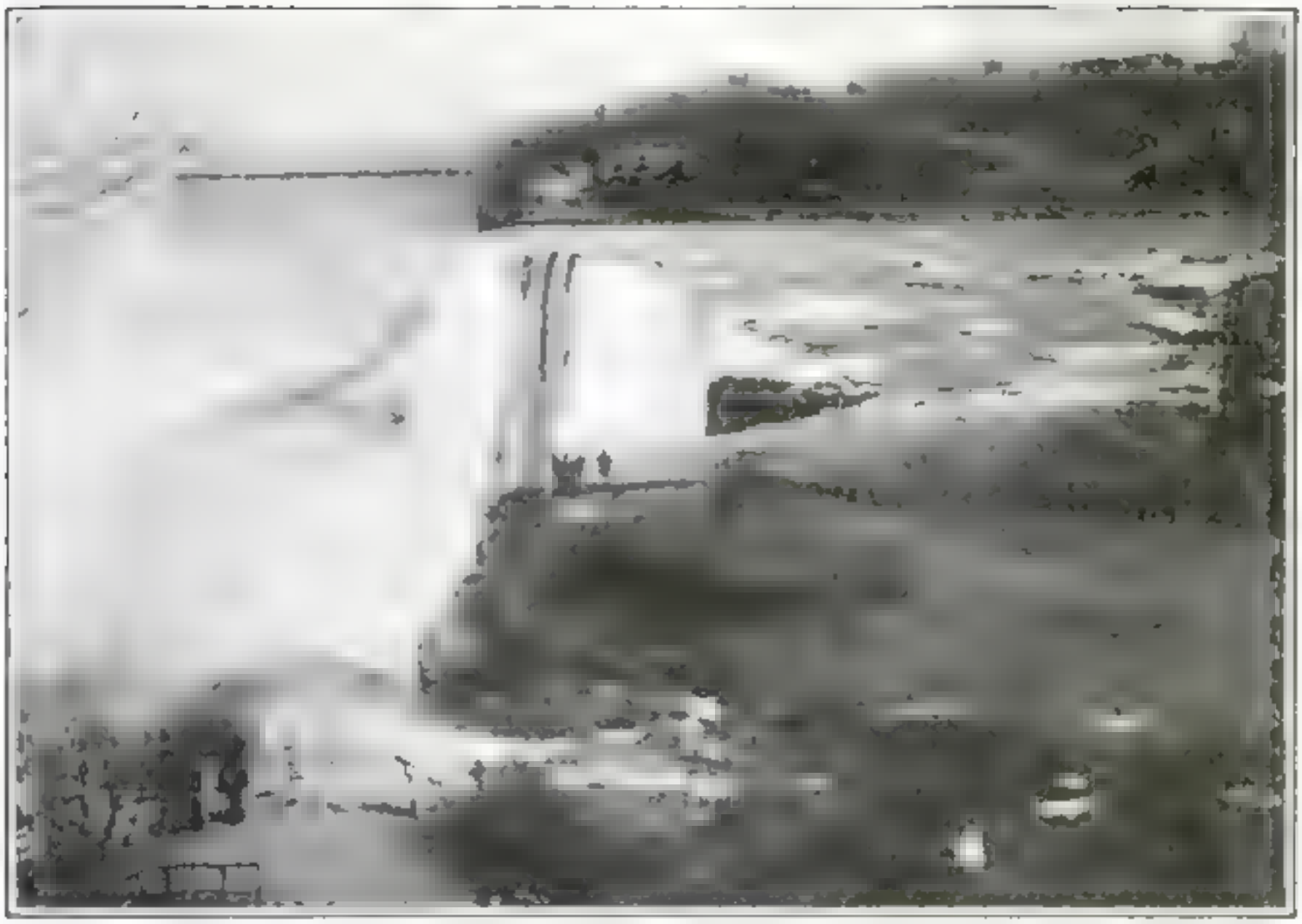
Synchronously with the vanishing of the falling tons of water, in thousands of workshops scattered over the fruitful territory of Ontario and New York, a million, perhaps many million, workmen begin their daily task. For fourteen hours the world's greatest beehive of industry is filled with the busy hum of activity, keyed to the highest pitch, banqueting, as it were, on the corpse of a murdered Niagara! One shift of seven hours is succeeded by another of the same length. All the energy of the seven million, four hundred thousand horse-power is devoted to the welfare of the nation.

It is 10 A. M. As the signal is flashed from the National Observatory the gates of the great dam shoot upward. The hum of spindle and loom, the clang of the triphammer, all the many-toned gamut of sound which forms the orchestral accompaniment of a busy, happy people shaping, fashioning, creating the objects of convenience or luxury destined for each other's comfort or enjoyment,—all sink to a whisper,—vanish!

A minute later and the crest of a vast billow sweeps over the brink of the American Fall. In an instant, almost, with a deafening roar of exultant joy, the cataract has sprung into full activity. Swiftly the falling curtain spreads from Goat Island along the crest of the semicircle, until Niagara, in full panoply of power and might, hurls her defiance at the assembled thousands gathered to witness the most wondrous sight on the face of the globe—the rebirth of a cataract. The spectacle would combine all the swiftness of movement and stupendous grandeur offered by the sweep of the Johnstown flood, or the tidal wave of Galveston, free from the tragic terrors and horrors of those cataclysms. The gloomy, beetling cliffs disappear behind the sheet of foam and spray; rainbows hover in the clouds of mist; the gray walls of the gorge echo back the roar of the proud cataract!

In a less dramatic and spectacular manner the level of water in the gorge would steadily rise; the foam and spray of the rapids become evident; the whirlpool resume its circling activity; and Niagara's normal life reappear.

For ten hours the thousands of machines, of furnaces, of electrolytic vats rest or are available for repairs, until the sun sets, and in the twilight the hour approaches for an eager multitude to witness again the death agony of a cataract unequaled in size.



A view of Niagara Falls when, a few years ago, ice dammed the river above and shut off all but a small proportion of the water. One of Prof Norton's plans would denude the falls each night still more than is shown here. When the water diverted by his dam to the running of his power plant, the "grand curtain would be rent and gashed as by invisible knives, a minute or two more, and rivulets here and there would pour over the brink . . . Another minute, and the rivulets have changed to drops . . . Niagara is silent!"

Such would be the daily sequence of events. On holidays, on the Sabbath, the lovers of nature could view the falling sheet of water at all hours of day and night, in the twilight, at dawn, in the solemn quiet of midnight

When used for motive power on railways, street-car lines, etc., in many branches of electrochemical industry, continuity of current is imperatively necessary. Storage batteries may be employed, but at an increased cost for each electrical unit.

It is, however, perfectly feasible to rescue a very large proportion of the power, ordinarily going to waste during the shorter period of the day, when the cataract resumes its normal activity, without affecting, to any noticeable degree, any elements of its scenic beauty.

In the deep recesses behind the falling sheet of water at Niagara, the Cave of the Winds, etc., a gigantic system of scaffolds could be erected. These would serve as the supports of a series of overshot wheels or endless chain-bucket wheels. By careful disposition a considerable fraction of the available power—possibly thirty to forty per cent—could be utilized and directed to electrochemical or transportation centers without revealing any portion of the mechanism to the eye of the beholder gazing at the cataract. There would be a noticeable increase in the volume of spray, which could tend only to heighten the scenic beauty of the waterfall.

The simplest means to accomplish the purpose would be a series of buckets, operating on endless belts, working on axes located immediately beneath the brink of the cataract and at the base of the falling sheet of water. Essentially an enormous overshot water wheel, with its modern effective devices on the periphery, distorted and elongated into the form of a belt, as used for the transmission of power from one shaft to another. A complete series of such elongated wheels, closely adjusted side by side,

would occupy the entire space behind the curtain of falling water, as far as their presence could be concealed from the view of those on the adjacent banks.

It is scarcely necessary to state that during the fourteen hours of enforced quiet and rest, while the waters of the Great Lakes are diverted through a maze of penstocks, to dash upon thousands of turbines, the sight of a serried array of mechanical devices, lining the cliffs of Niagara, would be sadly out of harmony with the otherwise gloomy grandeur of the gorge.

Although this period covers the time ordinarily devoted to slumber, still in the evening and during the early forenoon, tourists and others would constantly gaze upon Niagara at rest.

To remedy this feature, one per cent or less of the river's volume would be allowed to pass the dam, and flow over the brink. It would generate a thin curtain of water, just enough to hide the massive scaffolding and the maze of wheels. By simple hydraulic devices, this small amount of water could be largely transformed into spray. A delicate lace-like "bridal veil" would screen cliffs and every trace of commercialism.

The initial outlay would scarcely exceed two hundred million dollars. This is equivalent to a capital outlay of twenty-seven dollars per annual horsepower, based upon continuous use. The annual interest charge would be less than a dollar seventy-five. This approximates the rates of two dollars per annum in Iceland and of three dollars on the west coast of Norway. At present the electric power of Niagara costs twenty dollars per annum.

It would mean the creation of an industrial metropolis, surpassing any now existing on the face of the globe. No cinders or soot would pollute its atmosphere; no towering chimneys would rise against the sky-line. Industries of the most varied nature, carbides, carborundum, aluminum, cynamid, chlorin, alkalies, steel, copper, and many minor branches—all dependent upon the electric current—would gravitate to this point. It would become in very truth—perhaps in name—the *electropolis of America!*

A Mile-a-Minute with an Air-Driven Sled

IT was doughty old Count von Zeppelin who first pointed the way toward locomotion with an air propeller. More than fifteen years ago, when he first planned the giant, rigid airships which are now known by his name, he had to conduct a series of experiments in order to obtain propellers of sufficient thrust for his huge untried craft. Accordingly he mounted them upon a boat and made experiments on Lake Constance. The speeds which he attained were not more than twelve miles an hour, but they were sufficient to prove that he could urge his first giant vessel through the air at forty miles an hour.

The idea reappeared in France at a later date. Ordinary launches as well as specially constructed hydroplanes were driven on the Seine by propellers revolving in air. Tissandier and Santos-Dumont made speeds as high as fifty miles an hour on water. As in Count von Zeppelin's case, their experiments were prompted by the thought of obtaining a system of propulsion for air boats. So successful were they that a few motorcycles and automobiles appeared thus propelled.

Now comes an American manufacturer who reduces the idea to commercial practice. He has constructed an air-propelled sled with which it is possible to obtain a speed of sixty miles an hour over ice or packed snow. An engineering experiment, to test out the possibilities of an aircraft, has been developed commercially. The air-propelled ice-craft is now a vehicle of sport.

Notice the construction of the sled as it is depicted on our front cover. Upon a frame supported by the two rear runners a gasoline engine is carried, by which the air propeller is driven. A string-piece connects the motor-carrying frame with the single forward runner. There is room for two men. The rear man does the guiding with an automobile steering-wheel connected with the forward runner, which is pivoted so that it acts as a kind of rudder. Stop the motor and the whole sled can be checked and brought to a standstill very quickly by a powerful emergency brake.

A Sleeping Nest With an Electric Elevator

A CALIFORNIA electrical engineer has constructed a sleeping porch thirty-eight feet above the ground. He thinks that the night air close to the ground interferes with his repose, and that the temperature forty feet from the ground is at least ten degrees cooler. His sleeping porch is a veritable nest in a steel tree

He took pains to build his cage to withstand the high winds that occasionally prevail in that section of California. The steel poles which support the elevated bedroom are stoutly braced, and he has estimated it will be comfortably safe in winds blowing as briskly as two hundred miles an hour, thus allowing him an ample margin of protection

A miniature elevator lifted by a diminutive electric motor of one-sixth horsepower is employed in making the flight between the ground and the lofty bed chamber.

The owner of this sleeping nest cannot fly to his bed, like a bird, and so he installed an electric elevator

Publishing a Paper Aboard a Train

PERHAPS one of the oddest publications of recent years was that issued aboard a special train traveling between St. Paul, Minn., and Spokane, Wash. An entire printing equipment, including a linotype machine, a large cabinet of hand type and a printing press, was installed in the baggage car. The editors were selected from managers of the touring party and did their work in the parlor cars, and the paper was printed every day in the baggage coach. The press used was the first working model of a new type of machine.

While the editors wrote copy in the parlor cars, the newspaper was printed every day in the baggage coach

America's First Thirty-Five Knot Battle-Cruiser

COMMON sense teaches everyone that speed, range, striking power and adequate armor protection, are essential in a fighting vessel and the ship in which these are combined to a pre-eminent degree most fully meets the ideal. But it is no easy matter to unite all these attributes in a single craft of a given tonnage. If a battleship is excessively armored, weight must be saved elsewhere—in guns, engines, etc. And so it happens that every fighting ship is more or less a compromise effected by the advocate of speed with the advocate of heavy guns and thick armor.

Although the developments in battleship construction have been exceedingly rapid, the greatest impetus was given about ten years ago when Great Britain came to the fore with the Dreadnought, a ship which mounted only big guns, namely ten twelve-inch rifles. She was fast too, for her speed was twenty-one and one-half knots, something unprecedented in battleships.

Soon the superdreadnought appeared, a vessel still faster, mounting still bigger guns, and still more heavily armored Then came the battle cruiser, a formidable craft with a speed of twenty-eight knots—a type also first introduced by Great Britain.

These battle cruisers—vessels which mount somewhat fewer heavy guns than the superdreadnought, but of the same caliber, and which have somewhat lighter armor and the greatest speed that can be given to a warship are at last to be introduced in our own navy. If we were to engage now in a naval war with a foreign power, we would be hopelessly at a disadvantage, not only because of the fewness of our superdreadnoughts, but because we utterly lack battle-cruisers.

While no official announcement has been made of the principal features of these new ships, the POPULAR SCIENCE MONTHLY is in a position to present details which may be accepted as accurate.

Profiting by the lessons taught by the engagements fought off the Falkland Islands and in the North Sea, this new battle cruiser of ours is to have a speed somewhere between thirty-two and thirty-five knots. Obviously engines of enormous power are required to attain that speed, and so we may expect that one hundred thousand horsepower must be generated. Every additional knot means an inordinate increase in engine capacity.

Our unbuilt and unnamed battle cruiser will have eight fourteen-inch guns and twenty five-inch guns. At first blush it would seem as if the *Queen Elizabeth's* fifteen-inch guns must carry the day if these two ships were ever opposed. But our ordnance officers have made the statement that the new fourteen-inch guns which they have developed are the superior of the fifteen-inch guns at present used in the British navy—or statements to that effect

The armor protection of the new United States battle cruiser is to be twelve inches amidships and four inches at the ends. The *Queen Elizabeth* has thirteen and one-half inches of steel on the waterline, ten inches above that and a top layer of eight and one-quarter inches. It is here probably that we had to make our sacrifice in order to gain the engine power and, therefore, speed. But if speed will enable our ship to pick out her own position and our guns have the greater range, the loss in armor protection is more than compensated for.

The *Lion* and *Tiger* are battle cruisers in the true sense of the word. Our ship will easily outdistance them. In tonnage there is not much to choose, for they displace thirty thousand tons as against the thirty-one thousand tons of our vessel. In armament we will be far superior. The *Lion* and the *Tiger* each mount eight fourteen-inch guns which are probably inferior in range to the guns of equivalent caliber on the proposed American ship. The *Tiger* has twelve six-inch guns and the *Lion* sixteen four-inch guns; but weapons of such small character play no part in a long range engagement and are serviceable chiefly for the repulsion of torpedo boats.

The First Battle Cruiser of the United States Navy—a 35-knot Fighting Ship

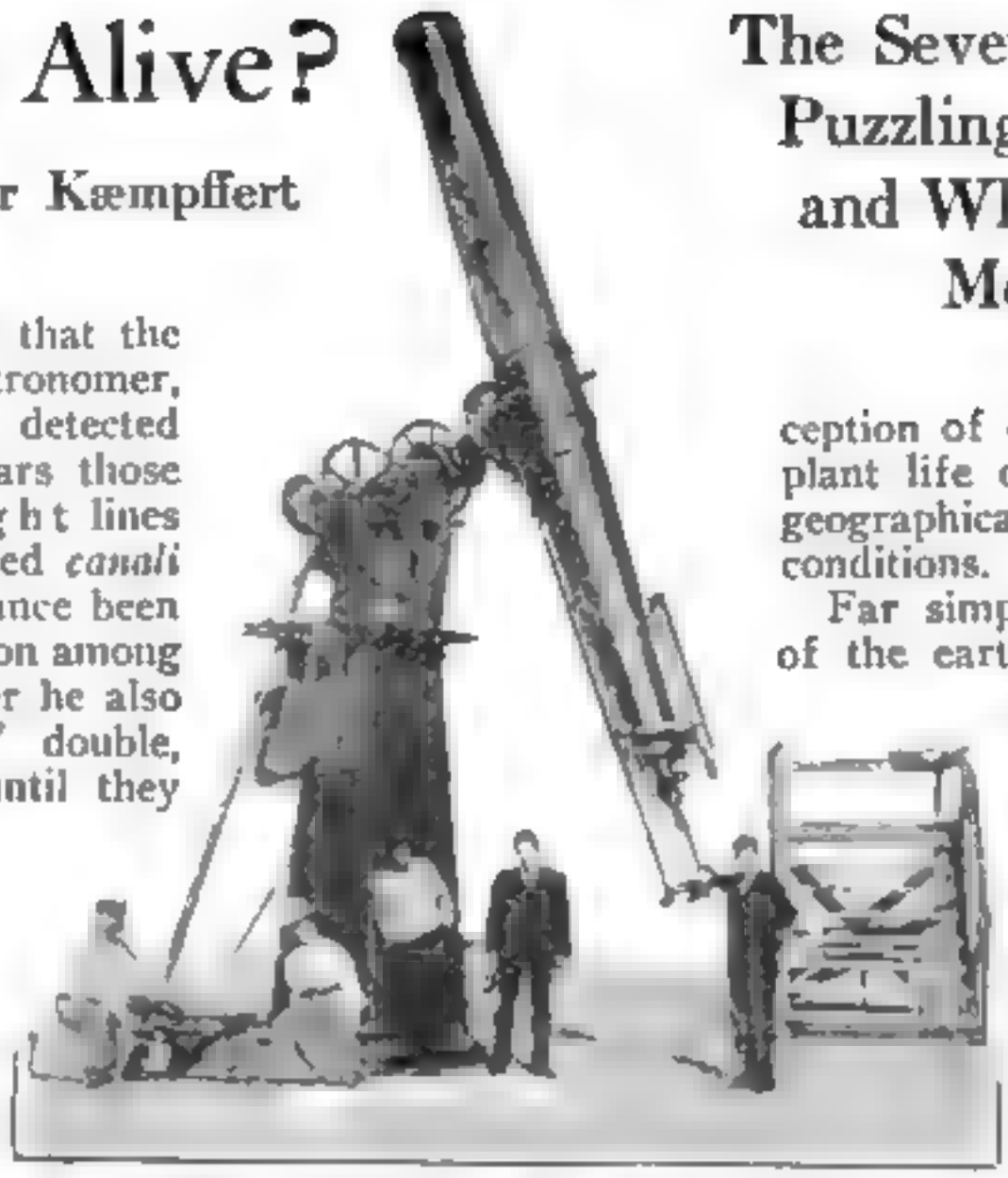
Length, overall, 730 feet; beam, 88 feet; maximum draft, 30 feet; displacement, about 31,000 tons, horsepower, 100,000; speed, 32-35 knots; armor, amidships 12 inches, ends 4 inches, main battery eight 14-inch rifles, secondary battery twenty 5-inch rifles; drive, turbine-electric

Is Mars Alive?

The Seven Hundred Puzzling Canals and What They Mean

By Waldemar Kæmpffert

IT was in 1877 that the Italian astronomer, Schiaperelli, detected on the planet Mars those curiously straight lines which he christened *canali* and which have since been a bone of contention among astronomers. Later he also saw his "canals" double, very curiously, until they looked like parallel railway tracks—something which has not been satisfactorily explained to this day. Now that Mars is about to approach the earth again, a number of observers, headed by Professor W. H. Pickering of Harvard, are to add their opinions to the dozens which have been delivered in past years, all without materially affecting the validity of Schiaperelli's work.



E. C. Slipher, of Doctor Lowell's staff, took this instrument with him to South America. The drawings of the "canals" made by Mr. Slipher with this instrument agreed in detail with those made at Flagstaff, Arizona

Although Mars can never approach us nearer than thirty-five million miles (which is much nearer than it will approach in February), we know more about its surface markings, in some respects, than we know about our own Earth. If the Earth were viewed as we view Mars, the only evidence of human handiwork that we could see would be the extensive grain fields of Canada and the United States. Of natural phenomena we would note the melting of the Himalayan and Rocky Mountain snows and the consequent flourishing of vegetation; the great caps of snow that cover the poles; the continents and oceans; and the clouds that girdle the Earth. If a Martian were asked to fathom the mystery of a planet of which he knew only these things, we would hardly expect him to form a very accurate conception of our animal and plant life or even of our geographical and physical conditions.

Far simpler is the task of the earthly astronomer who studies Mars. The planet is never obscured. No clouds, no veils of mist can dim the view; for the Martian atmosphere is ever dry, rare and severe, except around the melting caps. A weather prophet would have nothing to do on Mars. There is no weather—only the changes of the seasons.

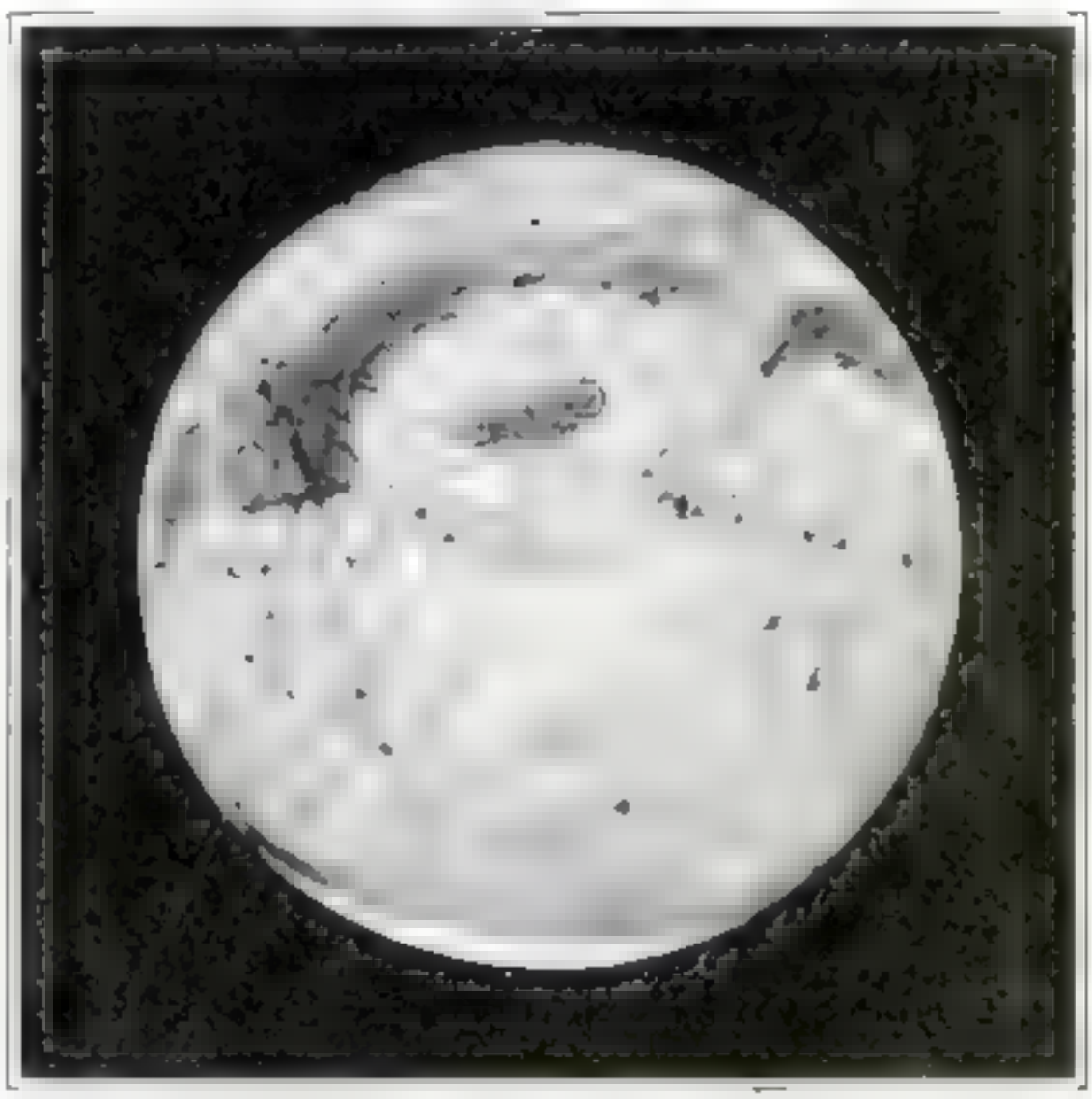
Watching the Snows of Mars

Soon after the telescope was invented and used for astronomical observation it was discovered that there is snow on Mars. During each Martian winter great white caps settle down on the poles; during each spring and summer they dwindle and disappear. In the dead of winter these white expanses may measure thirty-three hundred miles in extent

Besides the snow, astronomers long ago discovered that there are curious blue-green and russet areas on the planet. At a time when astronomy was not as advanced as it is now, the blue-green areas were supposed to be seas and the russet expanses continents, with the result that both were christened with picturesque but inapt names drawn from classical mythology.

Some years after Schiaperelli discovered the famous canals of Mars, Pro-

fessor Percival Lowell established at Flagstaff, Arizona, an observatory, equipped with the best instruments obtainable for the special study of Mars. He has gathered about him a corps of observers, who have become wonderfully skilled in refined Martian observation; he has the advantage of viewing the planet in an atmosphere unsurpassed for clearness; he has made his observatory the fountain-head of all important Martian discoveries. To him we owe our remarkably detailed knowledge of the planet's surface markings.



The distinguishing surface features of Mars are the snow caps at the poles, vast russet areas and blue-green regions between the poles, and the fine, straight lines which are known as "canals." Dr. Lowell holds that the straight lines are indeed "canals," and serve to conduct the water from the melting snows at the poles to the russet-brown areas, which are deserts, and cause them to flourish. Dr. Lowell's theory finds confirmation in the fact that portions of the russet-brown areas assume the characteristic blue-green hue of vegetation with the advent of Spring

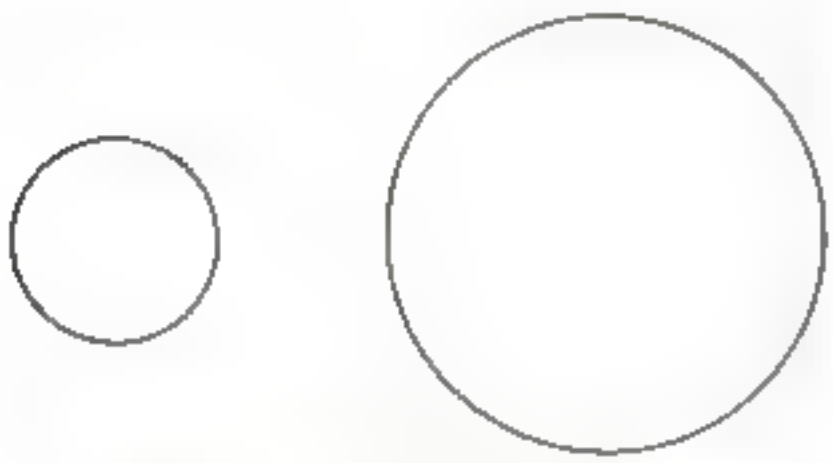
The Seven Hundred Canals—What Are They?

It was Professor Lowell who not only confirmed Schiaperelli's discoveries of the canals, but who plotted them accurately year after year and added to them until now their number is seven hundred and eighty-eight. It is he who originated and for more than twenty years has developed the theory that the canals are all that their name implies—artificial waterways constructed by intelligent beings. Perhaps it is because he has so persistently heaped one piece of evidence upon another to prove his theories that there is any Mars controversy at all. His opponents would probably be more inclined to accept the existence of the canals if he had not interpreted the markings of Mars in the way that seemed most natural and simple to him. It is certain that they accept without question the markings of other planets, plotted under the same conditions.

The significance of the canals is apparent when it is considered that nowhere on Mars is there any water except at the poles. Ages older than the earth, Mars has arrived at a pitiful condition which may best be described as deadly aridity. Long ago much of the fertile area of the planet shriveled to an immense desert. Oceans, seas, and lakes leaked into the interior by way of caverns and crevices, leaving only parched basins. The atmospheric gases have in part floated away, so that the air has become as rare and as thin as we should expect to find it miles above the Rocky Mountains. Whatever water still remains, gathers in the form of snow or hoar frost at the poles.

Clearly, if Mars is inhabited, Professor Lowell argues, the one supreme task that engages the attention of every thinking being on the planet is the utilization of that pathetically scant supply of water. If it were possible to conduct the water of the melting snows in spring to those portions of the torrid and temperate zones that would still bring forth, if properly nourished, a race might save itself.

In the canals Professor Lowell sees the life-lines of the planet. They are to him great irrigating trenches which con-



The relative sizes of the moon and of direct Mars photographs are shown by these two circles. The size of the moon to the naked eye is indicated by the circle to the left, the circle to the right indicates the size of a direct Mars photograph before enlargement. This disposes of the usual contention that the Mars photographs made at Flagstaff are no larger than pinheads

duct the water of the melting snows to fertile fields thousands of miles away.

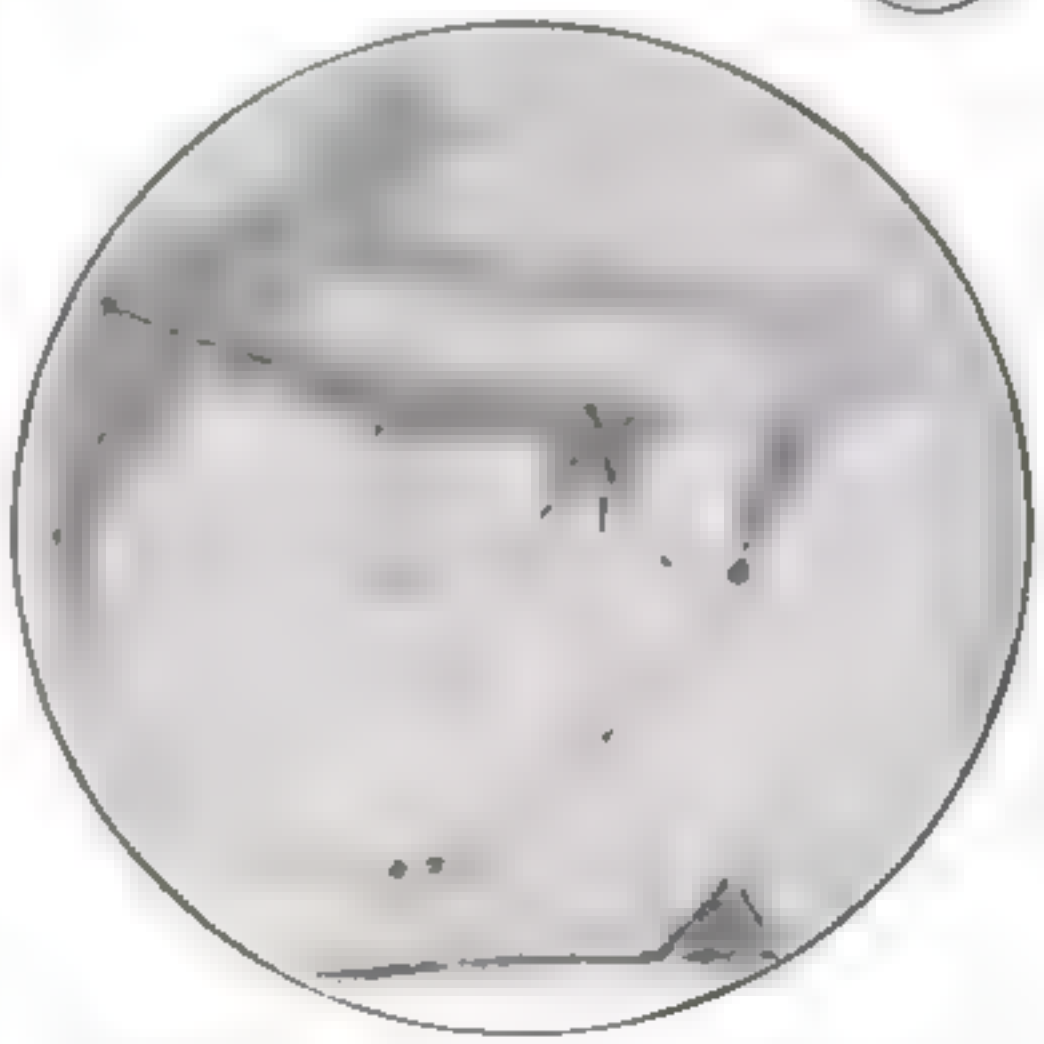
The Canals Are Irrigating Ditches

No more forcible argument in favor of this view can be advanced than their appearance and arrangement. Nature never works with mathematical precision. Yet the canals have been planned with mathematical foresight. No whim governed the choice of their direction. Invariably they terminate in large well-defined spots, from which they radiate like spokes from the hub of a wheel. If there were one spot, or even two spots, to which a pair of lines converge, we might look on the phenomenon as one of the natural features of the planet. But when more than a dozen lines run with geometrical directness to a single spot, and, when, moreover, the spots themselves are connected by lines and are in no sense isolated, we must assume that an intelligence has been at work.

Aptly enough the spots and lines are distributed in the very regions where we should expect a Martian engineer to place them; in other words just where water is needed. Were it not for their staggering length (fifteen hundred to four thousand miles), we should never see the canals at all. Viewed from a distance of more than thirty-five million miles even so large a city as Chicago or London would be no larger than the head of a pin. What we see is not really a waterway, but, as Dr. Pickering and Dr. Lowell has pointed out, the vegetation that fringes its banks.

Curiously enough, the canals disappear at intervals, only to reappear with their old clearness. On the face of it this would seem in itself an unanswerable refutation to any theory which assumes that the canals are irrigating ditches. It would be absurd for a hypothetical race of Martians to dig canals periodically, only to fill them again. But Dr. Lowell explains the disappearance very simply. What we see is but the seasonal growth of the vegetation along the banks. Time is required for the water of the polar seas to make

Size of Moon to naked eye



The relative visible sizes of the moon and Mars. In the small circle is a photograph of the moon (the size which it appears to the naked eye). In the large circle, is a drawing of Mars exactly the size which it appears through the telescope with a power of 392 diameters—the lowest used

itself felt; weeks must elapse before sufficiently luxuriant vegetation has sprung into being so that the courses of the canals can be traced each spring and summer. And the peculiar manner in which the canals seem to creep down from the poles at the rate of two and a half miles an hour lends color to the explanation.

Dr. Percival Lowell, who erected at Flagstaff, Arizona, the finest private observatory in the world for the special study of the planets. Here for many years he has made those observations of Mars which have made him the foremost authority on that planet in the world

The Growth and Death of Vegetation on Mars

This elaborate network of sluices divides the planets into plains of more or less geometrical shape. Blue, green and orange are the colors of these plains—colors that proclaim the character of the areas in question. The blue-green areas are fertile regions fed by the canals; the orange sections are deserts, hopelessly arid. This distinction Professor Lowell draws by reason of the peculiar fluctuations in hue which the blue-green patches undergo with the advent of spring and winter. As autumn approaches they assume a russet tint, which renders it almost impossible to distinguish them from the orange deserts. When the polar snows begin to melt they gradually deepen in shade until they assume the characteristic color of vegetation. Inasmuch as these changes are closely linked with the waxing and waning of the canals, it is evident that the one phenomenon is dependent upon the other.

That the spots toward which the canals converge are the objective points of Martian irrigation, is demonstrated by the scientific precision with which the canals have been drawn to meet them. Not a solitary spot is anywhere to be found. Three, four, six, even seventeen canals concentrate their floods on a single spot. In diameter the spots range from seventy-five to one hundred and fifty miles. Like the canals they have been designed with geometrical economy. If there are cities on Mars, it is not unlikely that they are situated in these spots.

Like the canals the spots disappear with the approach of winter; but before they are extinguished the canals have faded away. This is as it should be. Before our time the spots were thought to be lakes and were named accordingly. Professor Lowell regards them as oases studding the Martian deserts. Lakes would never deepen in color; only vegetation can cause the characteristic fluctuations to which the spots are subject.

Are the Canals Real or Merely Illusions?

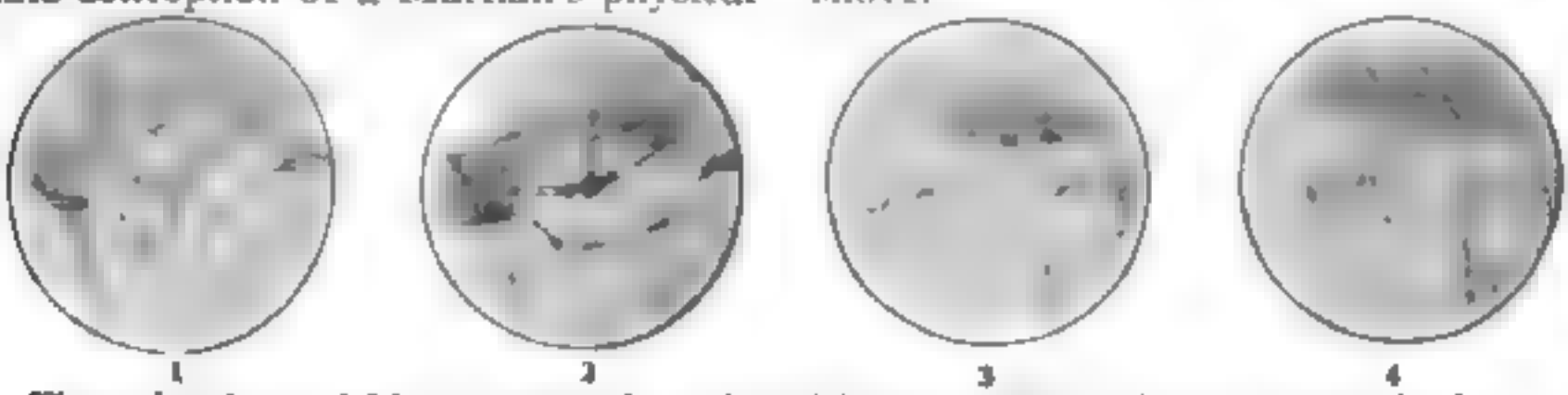
The amount of ink that has been spilled over the canals and their meaning would fill a hogshead. Many astronomers deny that the canals exist at all and regard them as optical illusions produced by eye-strain. But none of these skeptics has had the opportunity of studying Mars night after night in a clear atmosphere, far from the smoke of cities. Doubting astronomers who have troubled

themselves to journey to Flagstaff or other well-situated observatories are speedily convinced that the canals are objective realities and not illusions. Until 1907 the Flagstaff observatory was the only one devoted to the study of planets and especially equipped and maintained for that purpose. In that year M. Jarry Deloges, at the suggestion of Flammarion, started an investigation of Mars in France and Algeria. The result was an astonishing confirmation of the Flagstaff observations. So similar are the drawings of the Martian disk made nearly seven thousand miles apart that one set might well be taken for a copy of the other. If any evidence were needed to prove that the canals of Mars are real, it is surely found in the *actual photographs* which were first made ten years ago at Flagstaff by Mr. Lampland of Doctor Lowell's staff, and which have been duplicated over again by others since then. Unfortunately the detail in these pictures is so very fine that they cannot be satisfactorily reproduced in the pages of a magazine such as the POPULAR SCIENCE MONTHLY.

It must be admitted that it is not everyone who can see the canals. The man who is a successful observer of faint stars may be quite unable to detect fine planetary detail for structural reasons. Moreover, big instruments, especially in high latitudes, are rather a hindrance than a help in observing Mars.

Granting that Doctor Lowell and his followers are right and that Mars is a living world, what manner of beings are these who have dug canals to water their planet? Unfortunately, no adequate conception of a Martian's physical appearance can be formed, although Edmond Perrier, a French academician, some years ago boldly declared that they must be very tall and very blonde. Romantic guessing is not scientific deduction. Doctor Lowell in one of his earlier works shows that, while we can never hope to draw a picture of a Martian, we can at least deduce something about him because Mars is a small planet.

The bigger the planet on which you live, the harder it is for you to move about. A steam crane would be a welcome assistance in moving your body about on Jupiter. This is due entirely to the enormous gravitational attraction of Jupiter. The bigger the planet the harder are you pulled down to its surface. Mars is only one-ninth as massive as the earth. Hence you would weigh much less on Mars than you do on the earth. A Martian porter could easily carry as much as a terrestrial elephant. A Martian baseball player could bat a ball a mile. Because his planet is not able to pull him down with the attractive force that the earth exerts upon us, the typical Martian has conceivably attained a stature that we would regard as gigantic. Three times as large as a human being, this creature has muscles twenty-seven times as effective. His trunk must be fashioned to enclose lungs capable of breathing the excessively attenuated Martian air in sufficiently large quantities to sustain life As a canal digger—assuming that he had no machinery—he would be a great success, because he could excavate a canal with the speed and efficiency of a small Panama steam shovel



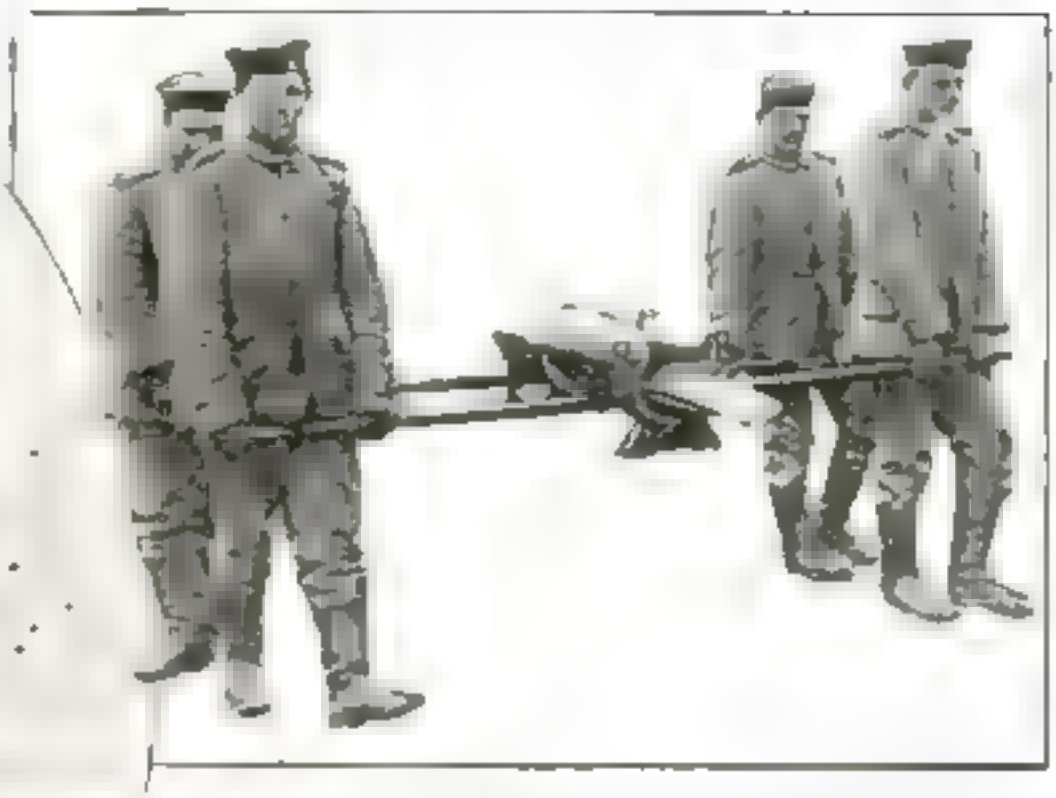
1 2 3 4

These drawings of Mars were made under different conditions by observers who knew nothing of each other's activities. And yet the pictures agree in their essential features. Drawing No. 1 was made October 21, 1909, by E. C. Slipher, of Doctor Lowell's staff, at Flagstaff, Arizona. drawing No. 2 was made by Jarry Desloges four thousand miles from Flagstaff on November 13, 1909; drawing No. 3 was made on January 21, 1914, with the Lowell 46-inch reflecting telescope, a magnifying power of 365 being used; drawing No. 4 made by Mr. Slipher about one hour later on the same night with the same instrument and the same magnifying power, shows the same important features

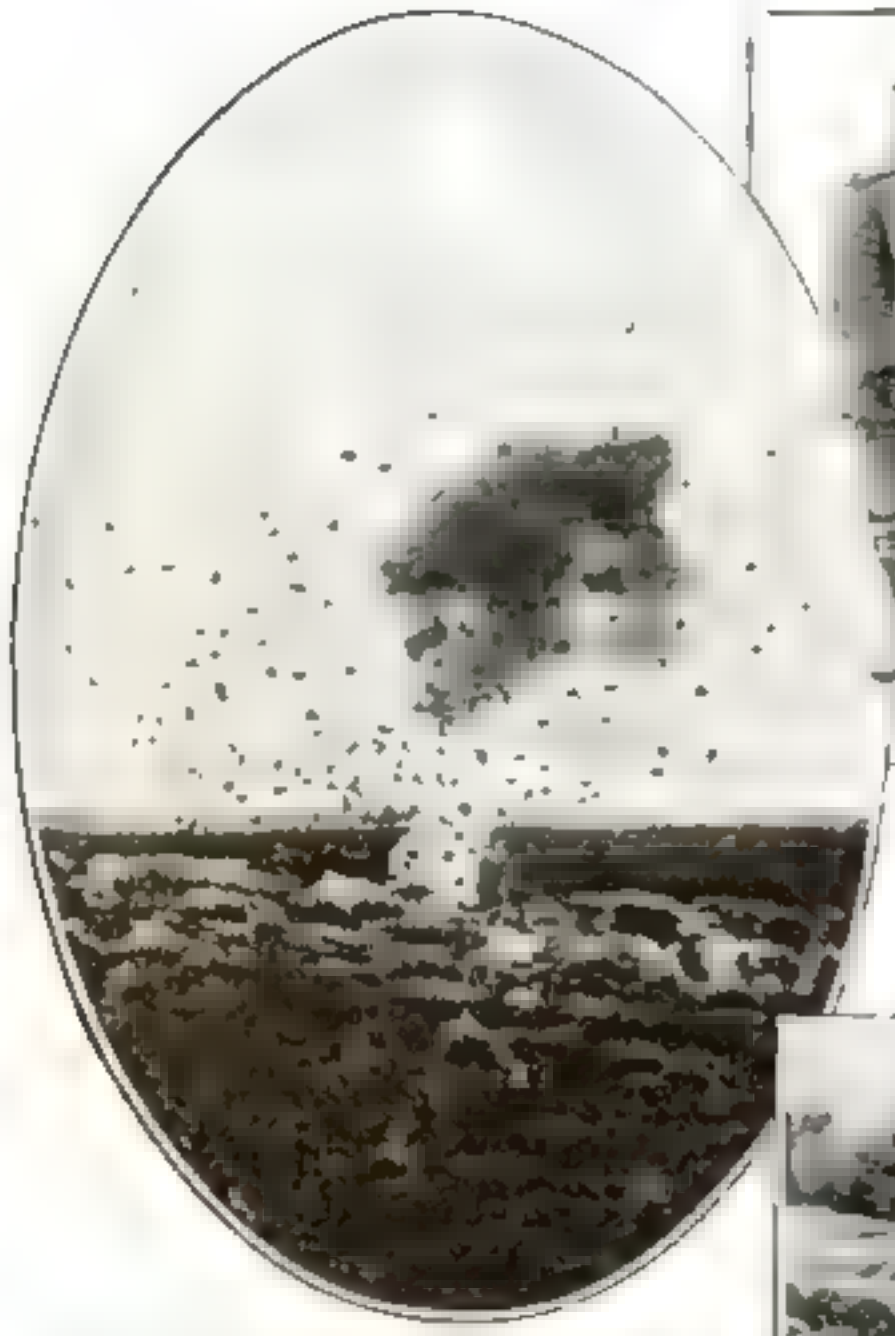
A Bridge of Boats

Towing a French pontoon to its proper position—work often done under fire. The bridge is practically completed before it reaches its destination. On arrival, it is anchored and the remaining flooring is laid to connect the different sections. (In the insert.) Cavalry shrinks from nothing—not even steep embankments. The horsemen in the picture are Russian Cossacks who are noted for their daring exploits

In this War of Big Guns



German artillerymen carrying a heavy 21-centimeter (8.4 inch) shell to the big gun emplacements which line the Russian front



An Austrian shell bursting close to the Italian trenches. The photographer who snapped this picture was buried under the earth thrown up by the explosion, and two men standing beside him were killed

Huge quantities of ammunition captured from the Russians are of Japanese manufacture. Above are a large number of Japanese shells, captured from the Russians near Grodno. Below is shown a fort in which the Germans found a complete equipment of Japanese artillery

Curious Phases of the War

Filling a French captive balloon from cylinders of hydrogen gas. The invention of this form of gas container permits of much more rapid filling of balloons, and dispenses with the old cumbersome generating plant which was formerly used

The clock of a destroyed belfry at Monfalcone, which continued to go for three hours after it fell

These field kitchens in the Aisne country have been concealed in caves by their French cooks, who are preparing meals as calmly as though they were at the Cafe de Paris

(At Left.) An incendiary bomb which fell on a London house during a recent Zeppelin raid

Where the Austrians and Italians are Fighting

The Italian army, with enormous effort, and overcoming difficulties the like of which are unknown on any other front, is endeavoring to drive the Austrians from their mountain strongholds. At present the action around Goriz, or Gorizia, holds the center of the stage, for unless they capture this fort, the Italians cannot hope to take Trieste. In the illustration, the Austro-Italian border is indicated by the broad white line. The heights of the mountains are indicated in feet

Austria's Natural Citadels

Austrian outposts watching the movements of Italian troops. Imagine the difficulty of storming this spot! Yet the Italians are every day attacking a seemingly impregnable mountain top. The suffering on both sides in the Alpine campaign is terrible, for the cold in the high altitudes is most penetrating, and snow-storms sweeping through the mountains cause the loss of many lives in both the contending armies

War Trades Practiced at the Front

An odd watchmaker's shop. An Italian watch maker who had been called to the colors took up his trade again when he arrived at the front. Underneath an army wagon he set up his shop

Many visitors to the trenches have brought away cigar lighters made of two cartridges. In one is placed the gasoline and wick, while the bullet of the other contains flint and a steel friction wheel

An outdoor blacksmith shop among the sand dunes near Ostend (below). Most of the German troops occupying the stretch of land along the coast of Flanders are sailors from the idle fleet. Their presence at the front has released a great number of soldiers for use along other sections of the line

Guns and Games at the Front

A card game at the cannon's mouth. These German officers are enjoying themselves while awaiting an attack upon their concealed gun emplacement

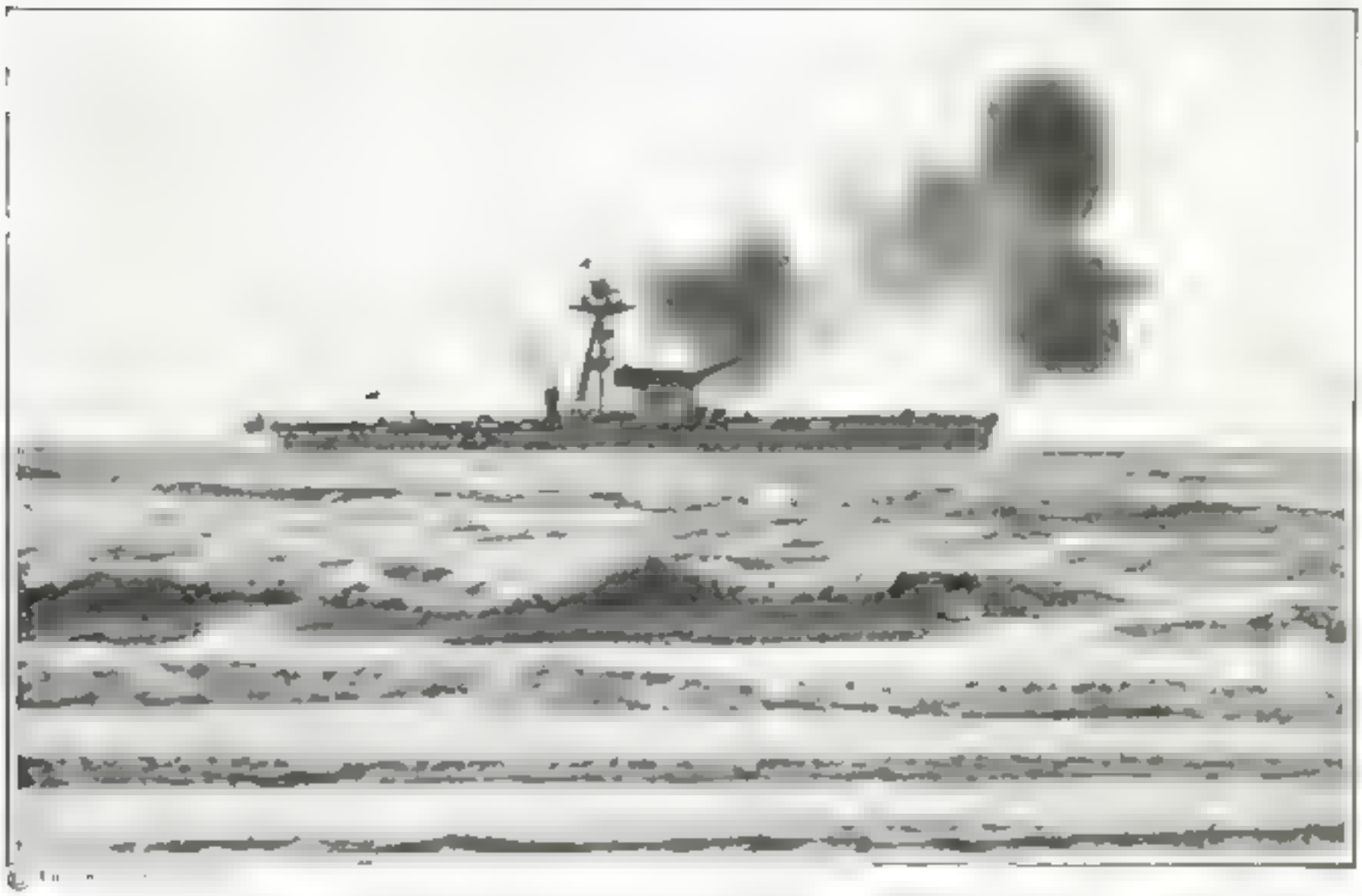
Bulgarian artillery being set up in the field. The Bulgarians were equipped with French Creusot guns during the Balkan wars. It is quite probable that they are still using these powerful guns

Cartridge belts for machine guns captured from the Russians. In spite of the tremendous losses in equipment, the Russians seem always able to secure enough to recoup their losses. The Japanese are now supplying the Czar's forces with war material to renew the equipment lost in last summer's retreat

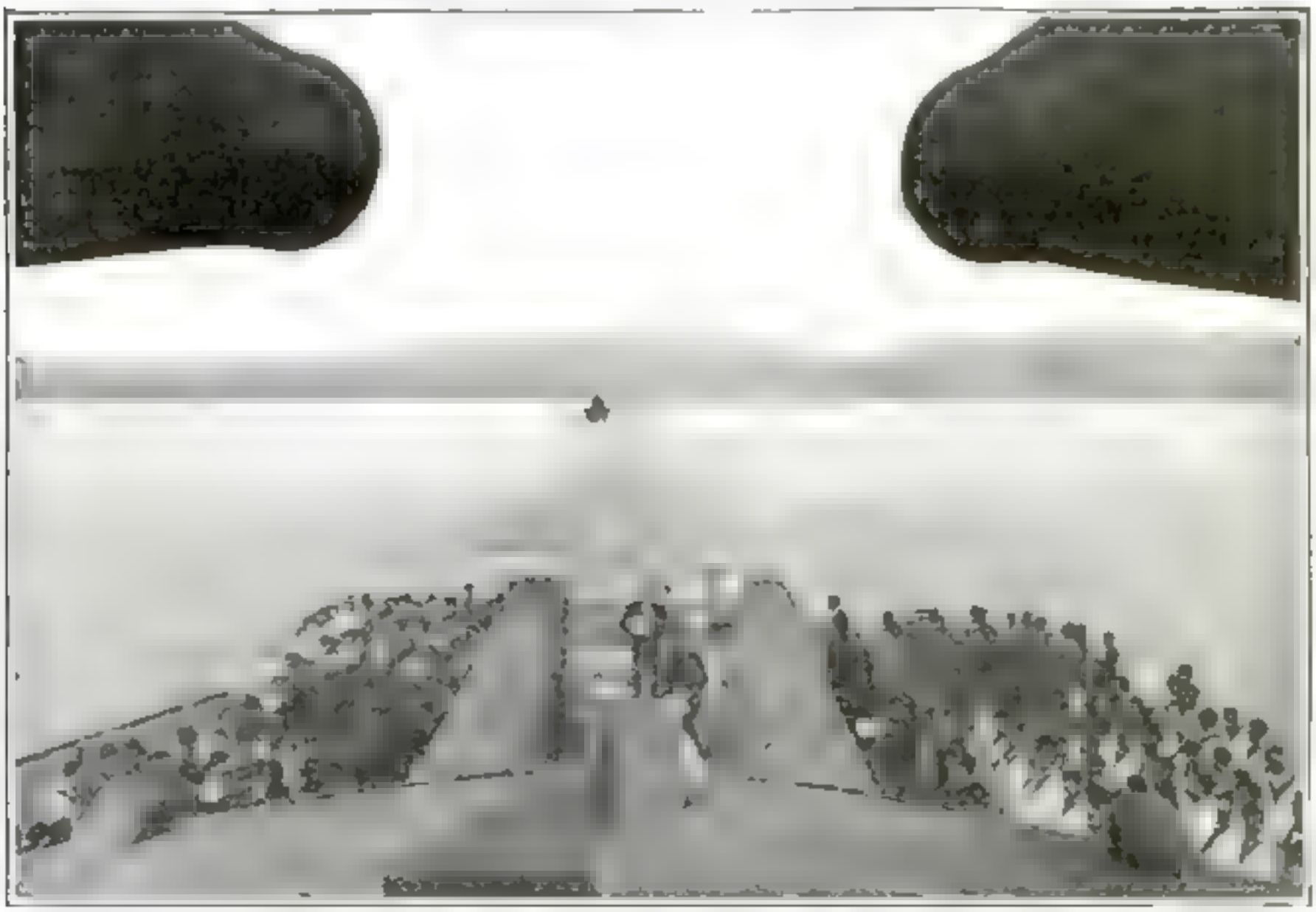
Building a mountain. This is not a ruined temple in Central America, but fodder stacked by Russian Prisoners for the use of German horses during the winter campaign. The Russians have gladly accepted the opportunity to work outside the war prisons

Caves are now used along the whole western front for the storage of explosives. With the aid of aeroplane scouts, gunners have been remarkably successful in dropping shells upon the ammunition stores of the enemy. Hence the need for caves

The Fangs of the British Navy



The first photograph ever made of one of the new British monitors in action. These craft are equipped with one fourteen or fifteen inch gun, and are very effective for coast bombardment. Six first-class monitors may be built at the cost of one super-dreadnaught, and are useful for coast attack as in the Dardanelles



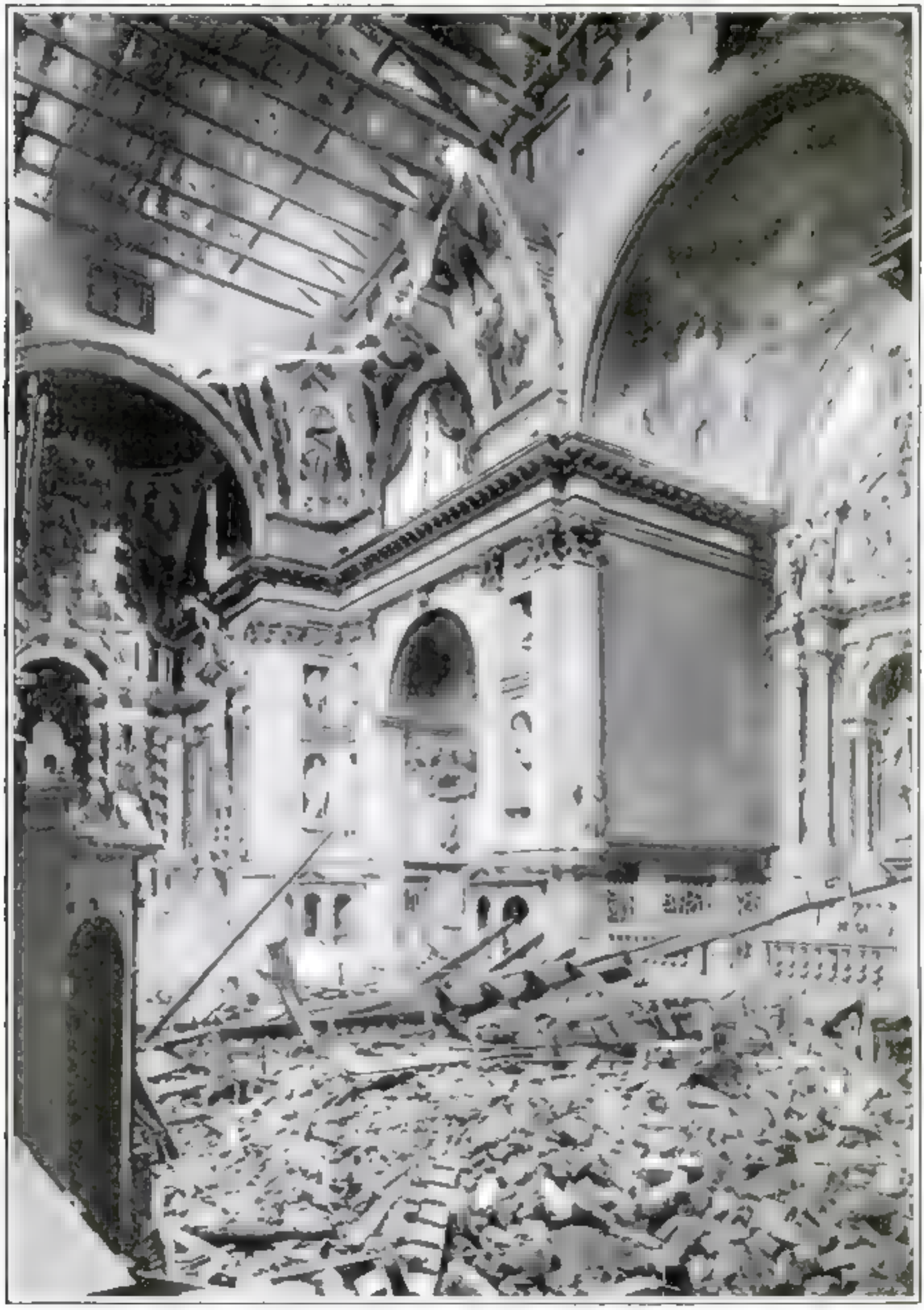
A view from the forward turrets of the super-dreadnaught "Queen Elizabeth," the pride of Great Britain's navy. The huge fifteen-inch guns shown throw a heavier shell than has ever been shot from a battleship before. During a bombardment in the Dardanelles, these great guns hurled their one-ton projectiles over a distance of nearly fifteen miles

Searching for the Best Respirator and Mask

Styles in poison gas masks change more rapidly than Parisian styles in bonnets. Officers and men are constantly searching for a more efficient mask which will enable the soldiers to resist the thickest clouds of asphyxiating gas. The favorite method of testing the efficiency of a new mask is to call for volunteers, who descend into a tunnel which is filled with the deadly fumes. Many volunteer to perform this hazardous experiment, though the outcome is uncertain at best. They know that it may mean the saving of many lives, even if it is at the actual sacrifice of their own. More and more the war resolves itself, in its minor phases, into battles of science, and science demands a laboratory. Here is the laboratory of the respirators

If these men come out of the gas filled tunnel unaffected, the mask will perhaps be adopted. At least, it will be given a further trial We have not heard how many of these devices have been tested in this manner and found faulty, but it is certain that many soldiers would rather be in the trenches than in a gas filled tunnel with an untried respirator

What War Means to Ancient Art



During a recent aerial attack upon Venice by the Austrians, a high explosive bomb fell upon the Church of the Scalzi and completely ruined the wonderful ceiling decoration which was renowned throughout the entire world. According to an art critic who examined the church, "Nothing but fragments of dust remain, and the loss is irreparable"

Women Shouldering the Burdens of War

A Serbian girl who is a pumpkin dealer. Serbia is now destitute of men in civilian occupations to a greater extent than any other of the warring nations

A modern Delilah. Yet they say that the war is too long London lightly!

Loading bags of coal for several hours a day can be considered a good day's work for the strongest man. Very few women would envy these Scotch women who are so valiantly taking the places of their fighting husbands

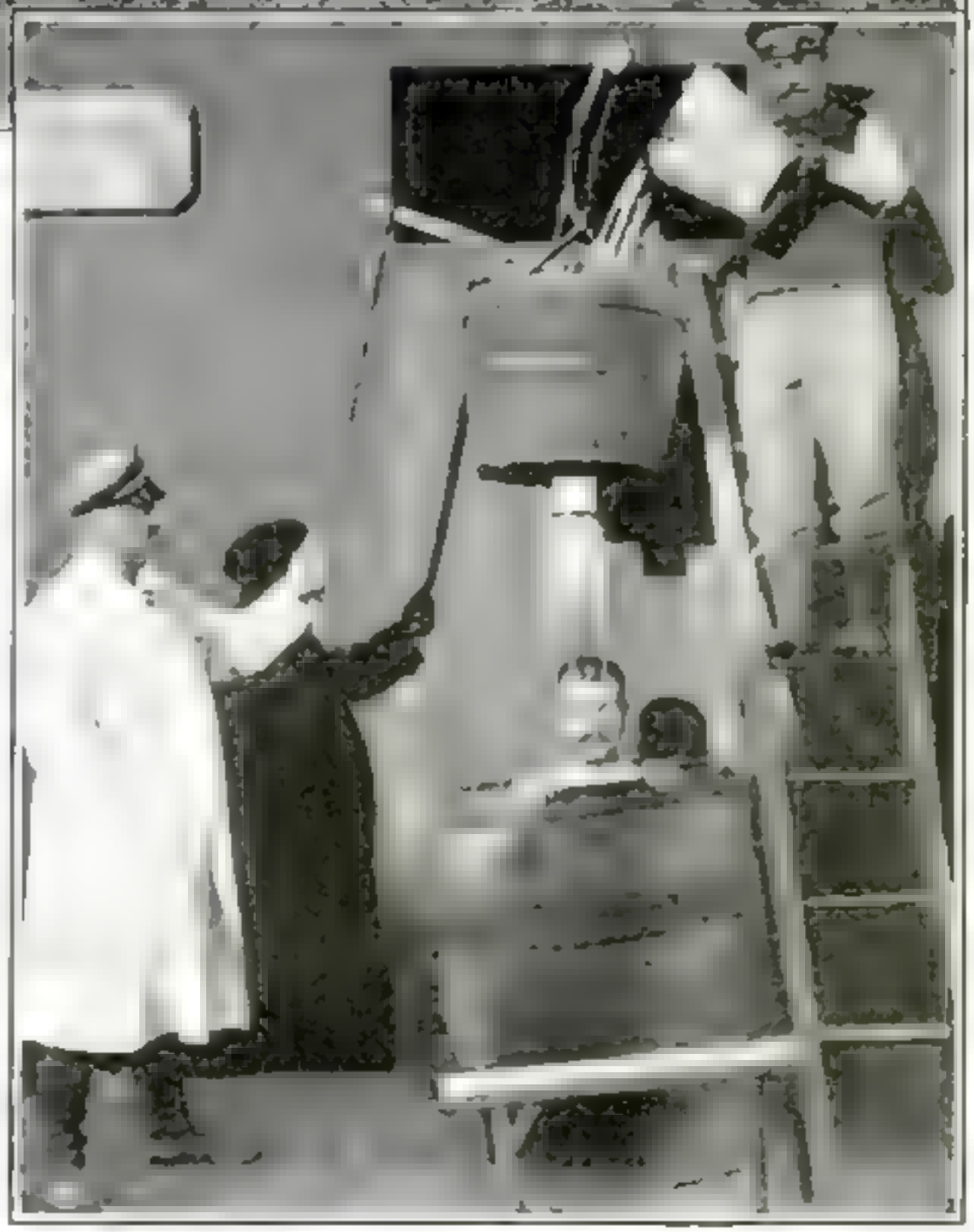
An Artillery Shell Used as a Bomb

Preparing a huge 220-millimeter (8.8 inch) shell for use as an aeroplane bomb. The French have adapted some of their artillery shells so that they may be dropped from aeroplanes during their frequent raids over German territory A percussion cap takes the place of the time fuse, and wings are placed at the large end of the projectile to keep it true to its course

A subterranean passage connecting two distant French trenches. Such is the danger of being shot by enemy sharpshooters while passing from one trench to another, that long communicating tunnels are dug. Sappers start from both ends, and meet in the middle. The illustration shows the first connection between tunnels which have been begun a considerable distance apart, and which are about to be united

The battery of pumps above is used to draw the water out of a flooded trench One motor pump would draw more water and in less time, and the German army is equipped with thousands of power driven pumps. Many of these hand pumps bear American trade marks, and much of the piping was made in this country also

On the right is an improvised open-air bath. A whole book could be written on the inventions of all armies for keeping clean under difficulties which vary with every new station, and with the ingenuity of the soldiers



The French Helmet's Practical Success

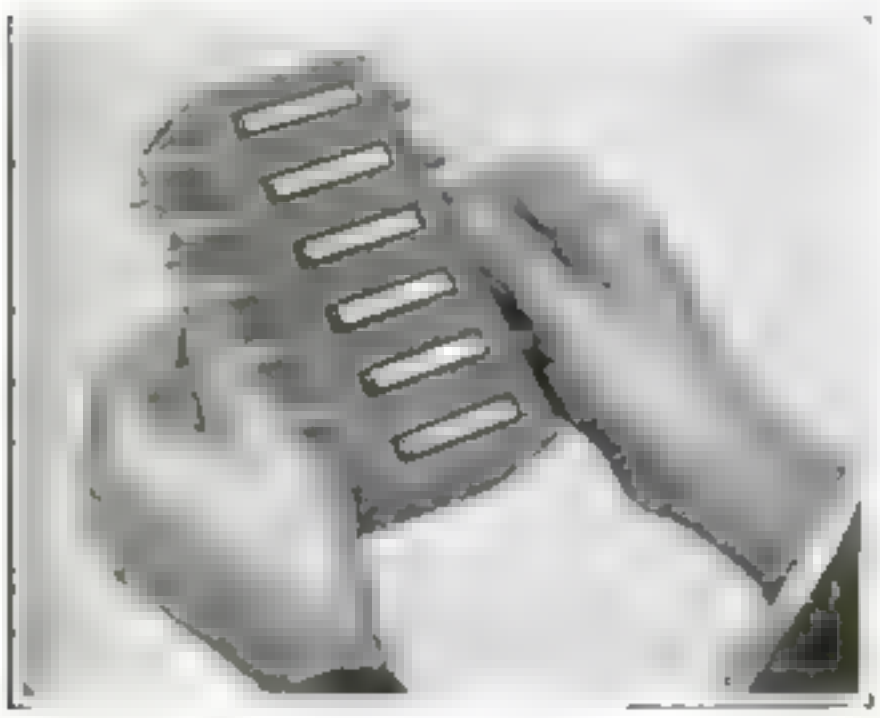
The new field equipment of the French infantryman. The French have gone far in their efforts to substitute for their comic-opera uniforms of blue and red a practical fighting costume, and they may now be considered as well clothed as any soldiers in the field. The steel helmet is the latest addition, and met with instant favor among the fighting men. The helmet is admirably designed, and tends to prevent the multitude of head injuries which have swelled the mortality rate. The illustrations of damaged helmets show the remarkable strength of this head-gear, for in all cases shown, the soldier was only slightly wounded by missiles which would otherwise have killed him

Collecting copper and brass is still in vogue in Germany. The little boys of the large cities enjoy the work, they look upon it as a new sort of game. All copper and brass utensils are bought by the German government and market prices paid for the metal

The Christmas spirit, strange as it may seem, was prevalent in the very trenches that are the scenes of the greatest slaughter. In many parts of the battle line foes became friends for a few hours, and after exchanging greetings and cigarettes, went back to the deadly game of killing each other. Here we have a picture of Father Christmas, a soldier, on his way to present the children of a half-ruined village with a few simple toys made by his comrades

A Machine That Thinks Up Movie Plots

NEARLY every one of us believes that in the back of his brain he has a perfectly good moving picture scenario that awaits only the chance to be flashed upon the screen. He is now given an opportunity to produce, by the demand for scenarios in a field where hundreds of new stories are filmed every week. And now comes an opportunity,



Turn the handle and new words appear on the face of this machine—words that suggest plots for motion picture plays

in the form of a plot manufacturer, for those without ideas, a compact little cardboard box that contains more plots than the moving picture people could use in a hundred years.

The "movie writer" as it is called, is exceedingly simple. Arthur F. Blanchard, of Cambridge, Mass., who is a Harvard graduate, is the inventor, and he believes his machine will revolutionize literary art. The device consists of a modest cardboard box six inches long, three inches wide and two inches deep. Half a dozen slots are cut in the top surface, beneath which revolve spools of paper upon which are printed several thousand scientifically selected words. Handles project from either side which are turned at will.

The word in the top slot is an adjective, that in the second a noun, the third a verb. Next comes another noun (the subsidiary character) and then follows a word expressing a *denouement*. Each knob is given a few twists, either selectively or at random, and a complete plot, perhaps extravagantly impossible, perhaps hackneyed, or perhaps new and useful, turns up. But at all events there will be a plot. Here are a few samples; imagination must supply the details.

Beautiful, stenographer, bribes, customs officer, adventure, recall.

Benevolent, steward, captures, empress, affair, reflection.

Chivalrous, stranger, dares, governess, alliance, repentance.

Cowardly, author, deceives, editor, anguish, rejection.

Bold, beggar, blackmails, broker, brawl, banishment.

As a toy, the mechanical plot creator also has its uses. With each person at a dinner provided with one of the machines, a story can be started by the first person, the others following in turn, each based upon the preceding one and carrying the story. It remains to be seen how many successful picture plays result from the use of this invention.

A French Motor-Tricycle Sweeper

JACQUELIN, the French champion cyclist, has conceived the idea of attaching a rotary brush to the back of the motor-tricycle. His novel combination attracts much attention, in operation upon the streets of Paris.

To a light frame, made over steel tubes, the motor-tricycle is attached, and this frame holds the brush and is driven by a chain from the rear axle of the cycle. A basket of the proper shape lies next to the brush so as to receive the sweepings, as the work proceeds.

That a professional cyclist should have invented this street-sweeper is natural. But why use muscle when gasoline motors are cheap?

The Latest Style in Handcuffs.

LAWBREAKERS may be nipped in the bud most effectively by the police nippers invented by John J. Murphy of Norwich, Conn. The police nippers or "leaders," as they are sometimes called, are clasped about the wrist or even the ankles of the arrested man.

The advantage of the new nippers is not alone in their effectiveness but also in the fact that they may be quickly and easily operated with one hand. The closing of the hand about the handle portions of the nippers causes the jaws to close. These are pivotally connected by opposed extending arms with a sliding tubular member attached to the T-shaped inner handle. This tubular member slides on a basic rod to which the outer T-shaped handle is mounted. It takes but an instant to clasp the nippers on the wrist of an offender.

Have You Eaten Your Cow?

EVERY man, woman and child in the United States eats, each year, a whole steer, sheep or hog, according to United States government figures, which show that one hundred million meat animals are slaughtered in this country each year

Of one's beef, mutton or pork, however, one has to give up one and one-half per cent, on account of condemnation by government and city officials, for this proportion of the meat slaughtered is thrown out as unfit for use. The federal inspection covered, last year, fifty-eight million meat animals slaughtered, and condemned 299,958 whole carcasses, and 644,688 in part. This represents considerably more than that number of cases of ptomaine poisoning which government inspection saved Americans, but it also represents a considerable saving in other diseases.

Tuberculosis was the chief disease condemned, 33,000 beeves and 66,000 pork carcasses being entirely condemned and parts of 48,000 other beeves and 440,000 other swine being removed. Hog cholera was responsible for the next largest loss, nearly 102,000 swine being condemned entirely on this account.

It cost the taxpayers $3,375,000 for this protection, or four cents a head for the population of the country, which was paid for when they bought their beef, sheep or hog for the year. In selecting one's diet for the year one should bear in mind the additional fact that over half the number of food animals inspected by the federal government last year were hogs.

It will be difficult for a thief to escape the clutch of the law if these new "nippers" are adopted, for they can be quickly and effectively operated with one hand

The Home Engine of Many Uses

The portable gasoline engine makes possible the watering of lawns and parks where the source of water supply is a nearby lake or stream

THE farmer is probably buying more gas engine horse power today than any other half dozen general classes. Besides being the most generous purchaser of motor cars and practically the sole buyer of tractors, he purchases the greater part of the half million stationary and portable engines turned out annually by several hundred American manufacturers.

Few farms are now without a gasoline or kerosene engine—many have two, and some of only fair size have five or six, all busy. The average size of engine is increasing rapidly (now probably about six horse power) and as farmers become more familiar with them, these handy power plants are daily put to a more varied and more nearly constant use.

The great majority consume gasoline. The danger of a gasoline famine, so imminent a few years ago, has been averted for the present, at least, and the heavy-oil engine has not made much headway in the small units adapted to the farm.

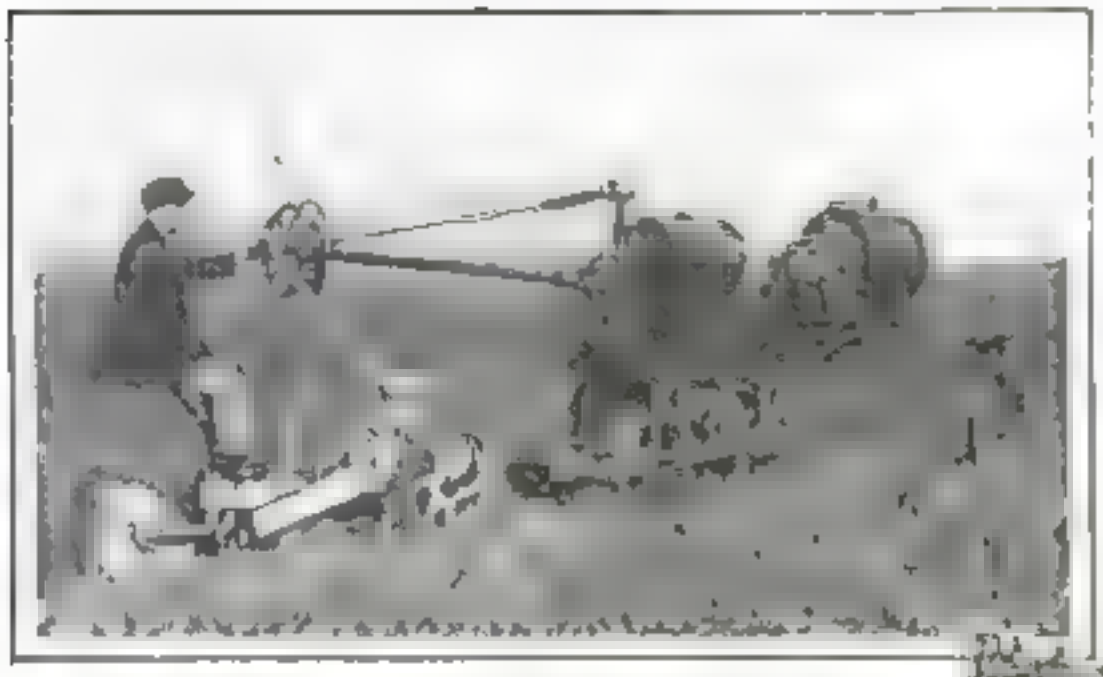
Farm engines, other than tractors, are almost wholly of the single-cylinder type, both vertical and horizontal being widely used. Some manufacturers make both, not only to give the farmer his choice, but to provide more than one dealer in a town with an "exclusive" agency.

Most of these engines are stationary or semi-portable, i. e., mounted on skids. Many are portable (on wheels), and this is especially true of the larger sizes. The usual range is from one to thirty horse power. Roughly speaking, skid-mounted engines range from one to eight horse power, and the portable from ten to thirty-five horse power or larger. The tractor has taken the place of many of the larger portable units, and is rapidly encroaching on the smaller portable field. However, there is a growing demand for the light-weight, high grade throttle governed type, so easily adaptable to many uses.

The versatility of the gasoline engine in the farmer's hands is really remarkable. A one horse power model may play the part of a chore boy about the house, while a larger size may be at work around the barn and a still larger one be doing heavy work somewhere in the open.

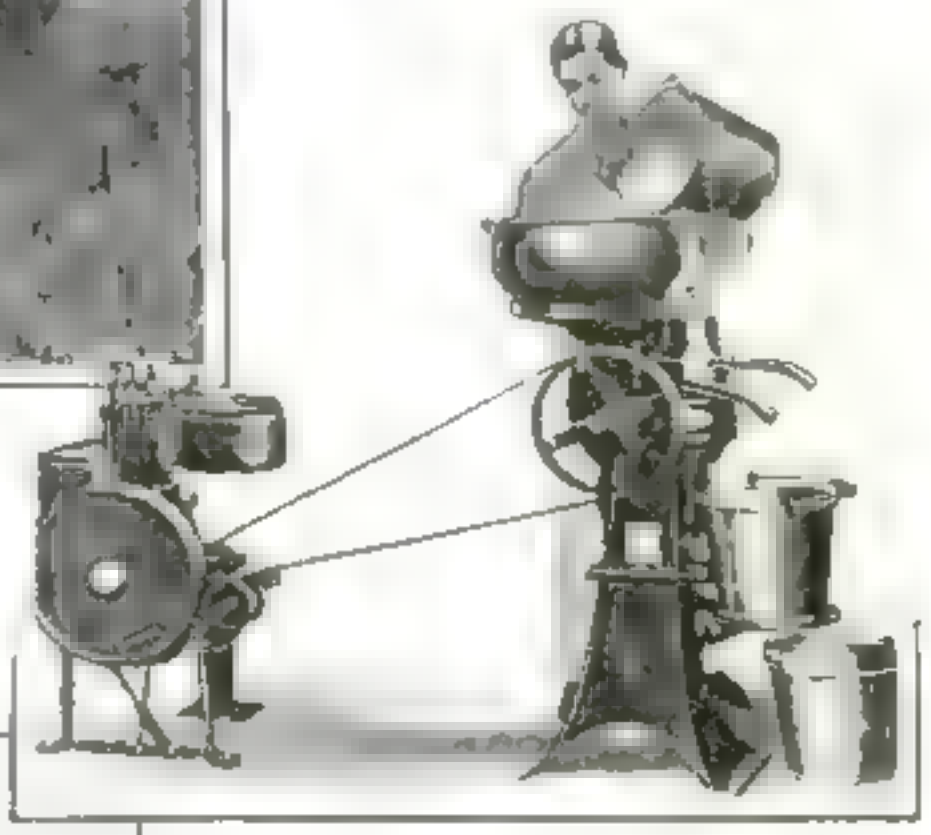
The washing machine, cream separator, sewing machine, churn, grindstone and some of the lighter machines in the workshop call for the smallest engines. A two or three horse power engine may be the mainstay of the farm water system and run the milking machine. The electric lighting plant, plus the work just mentioned, may call for four or five horse power, whereupon the corn sheller and feed grinder are brought in to keep the power plant busy.

From this point upward the character of work changes less than the size of machine for doing it. Saws, feed mills, grain elevators, hay balers, etc., may use only a few horse power or the full



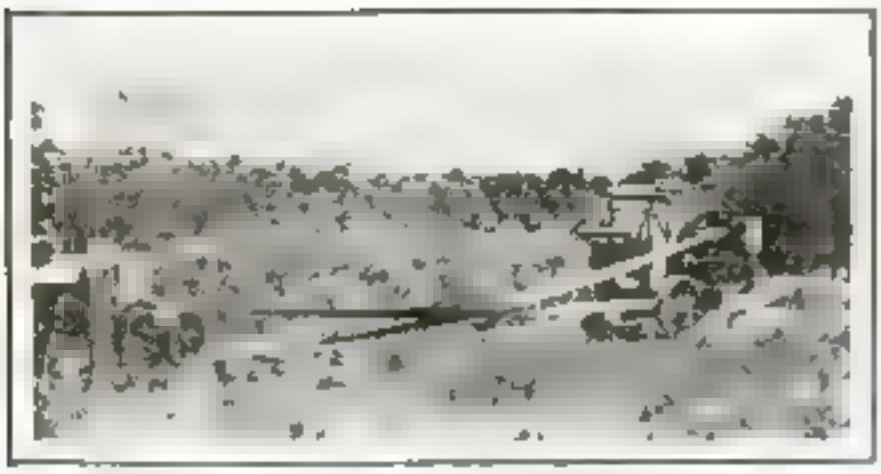
A traction engine of novel form at work. This machine is one of the many attempts which have been made to supply a small traction engine which can be profitably used upon farms of moderate size. The problem of supplying such a tractor is more difficult than that of a cheap automobile

Running a cream separator with a small engine. The same engine can be employed for other dairy work and for dozens of other uses on the farm

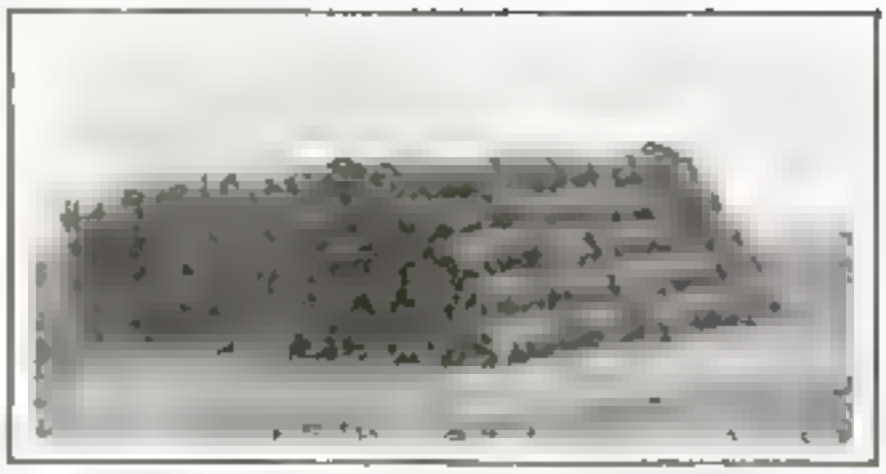


So varied is the work to be done upon a farm that the engine must be readily movable from one place to another. The photograph shows a small engine which has been mounted upon a truck so that it can be readily shifted about. It has been geared with wheels so that it can be attached to the mower shown, which can be run by a thirteen year old boy and faster than with horses

Above is an installation which shows how a gas engine can be used to drive a conveyor by means of which a wagon can be loaded, or hay or grain stacked and stored. At the left is an engine used to churn butter and pump water at the same time

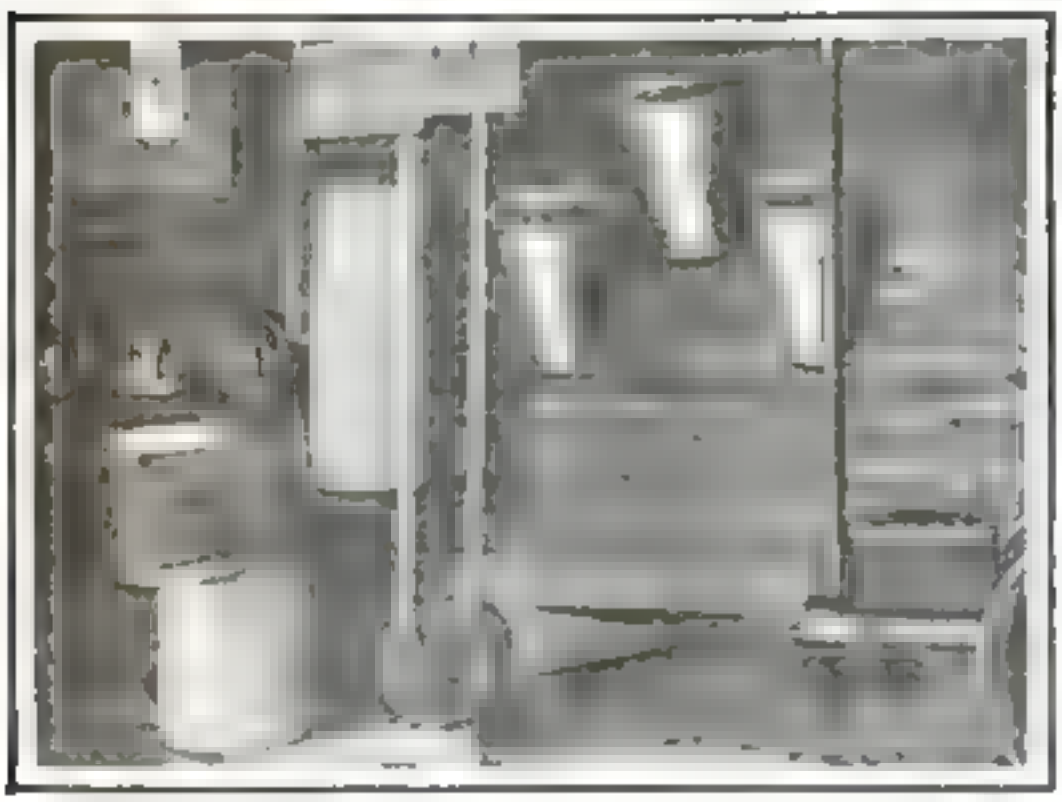


Gasoline engine used for irrigating one hundred and fifty acres

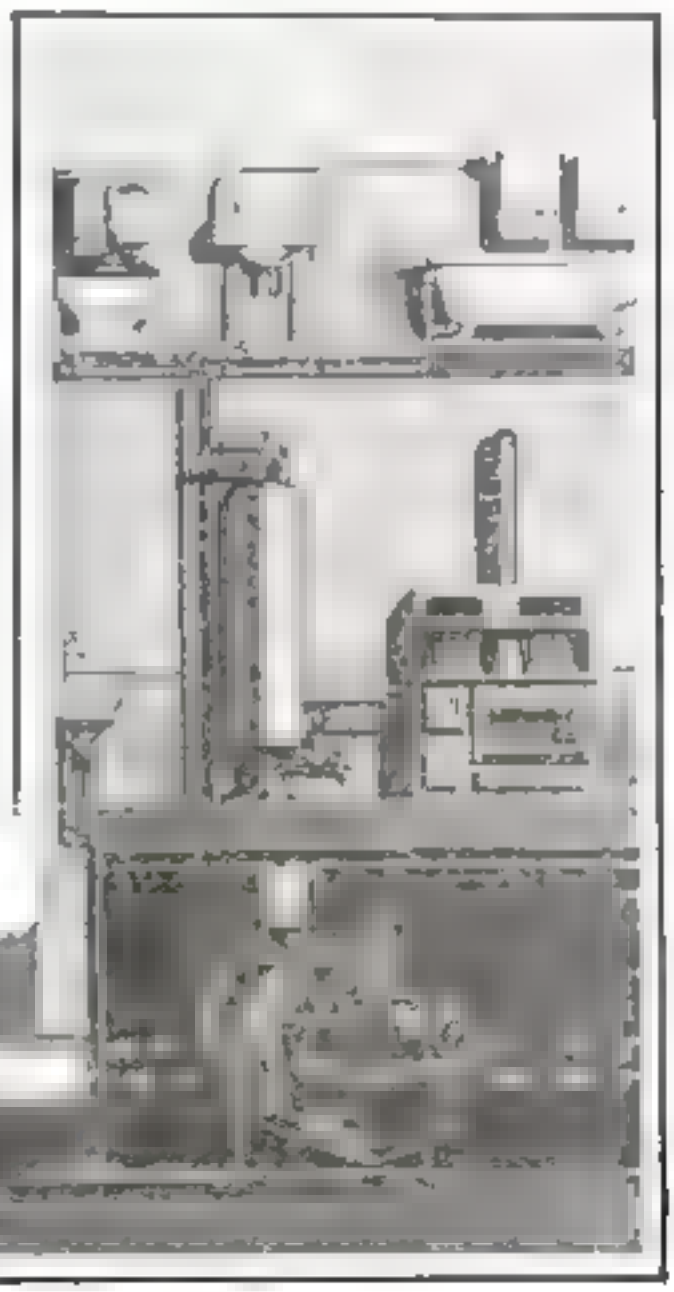


Circular bales made by the gasoline baler shown on the opposite page

Unloading alfalfa and hoisting it into a barn with the aid of a portable engine

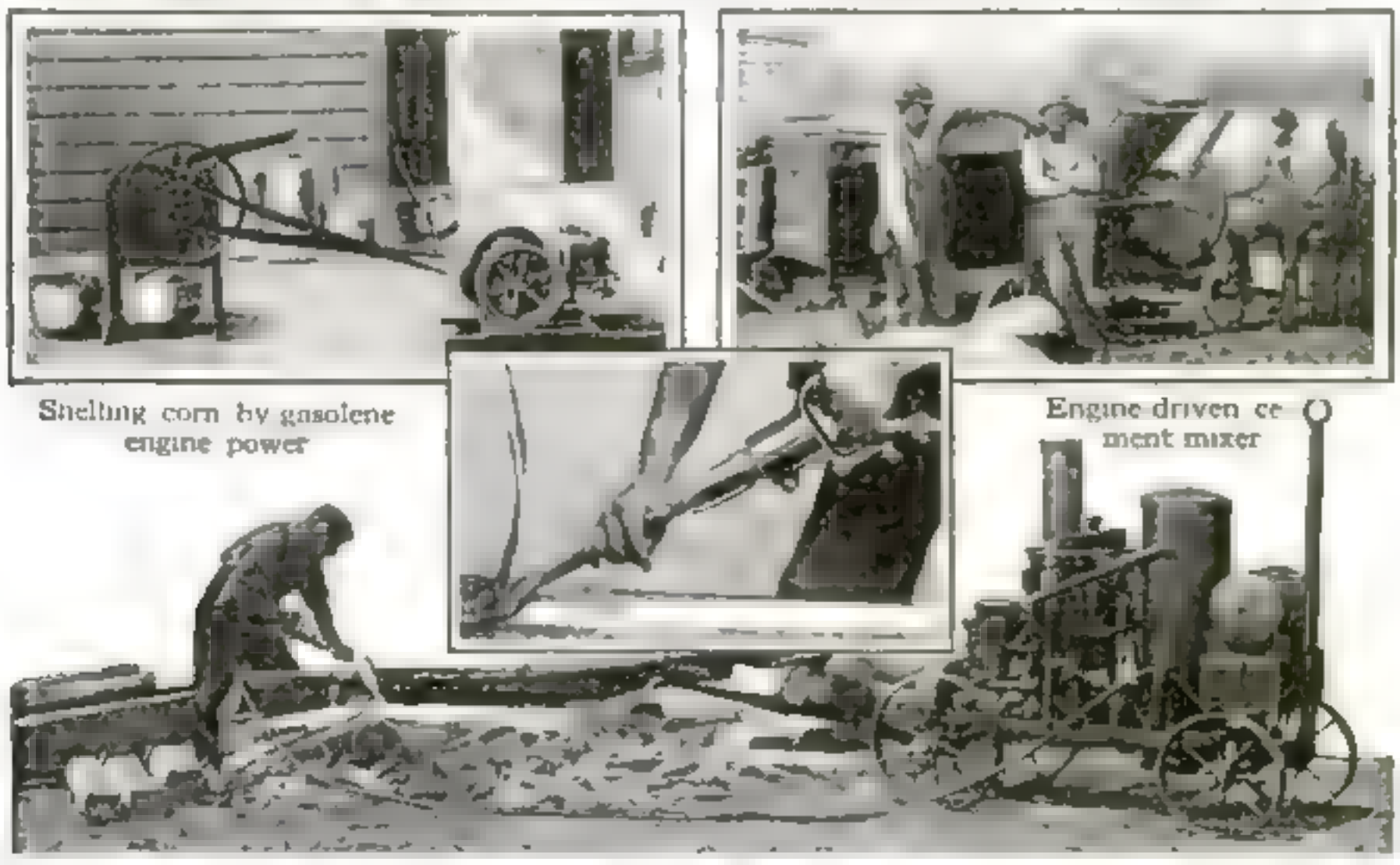


Engine power is the most economical for running the separator, milk-testing machine, churn, mechanical milker and other devices of the dairy

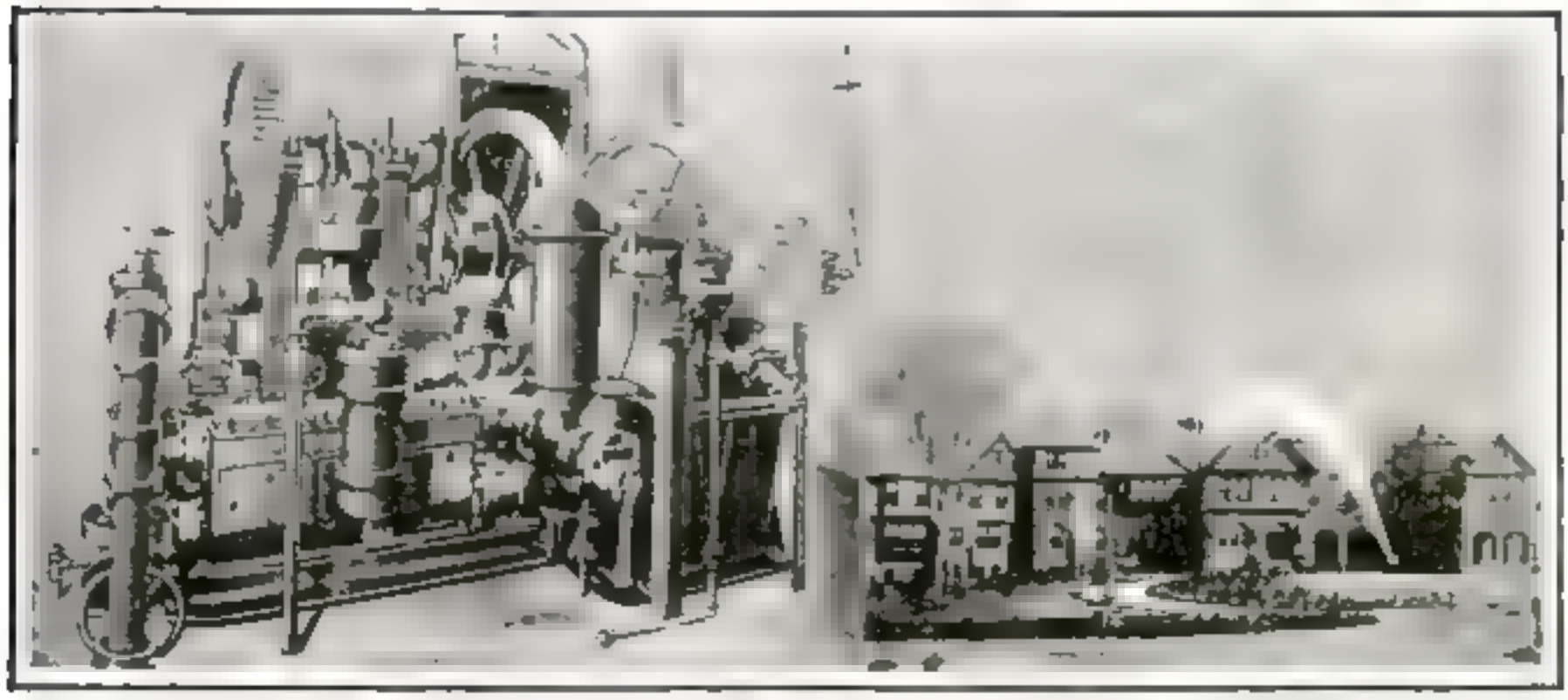


An engine-driven water power plant for the small home is one of the luxuries brought by the gasoline engine

The engine-driven hay baler at work. It makes the bales shown on the opposite page



A portable engine driving an air compressor operating a pneumatic timber stripper



A typical power and water pumping plant for a large residence or institution.

Spraying trees in a park with the aid of an engine mounted on a horse-drawn truck

A gearless two-horsepower engine which pumps from a deep well

A drilling well at work at Amarillo, Texas. Power from a traction engine was used

A twenty-two horsepower gasoline engine driving an attrition mill

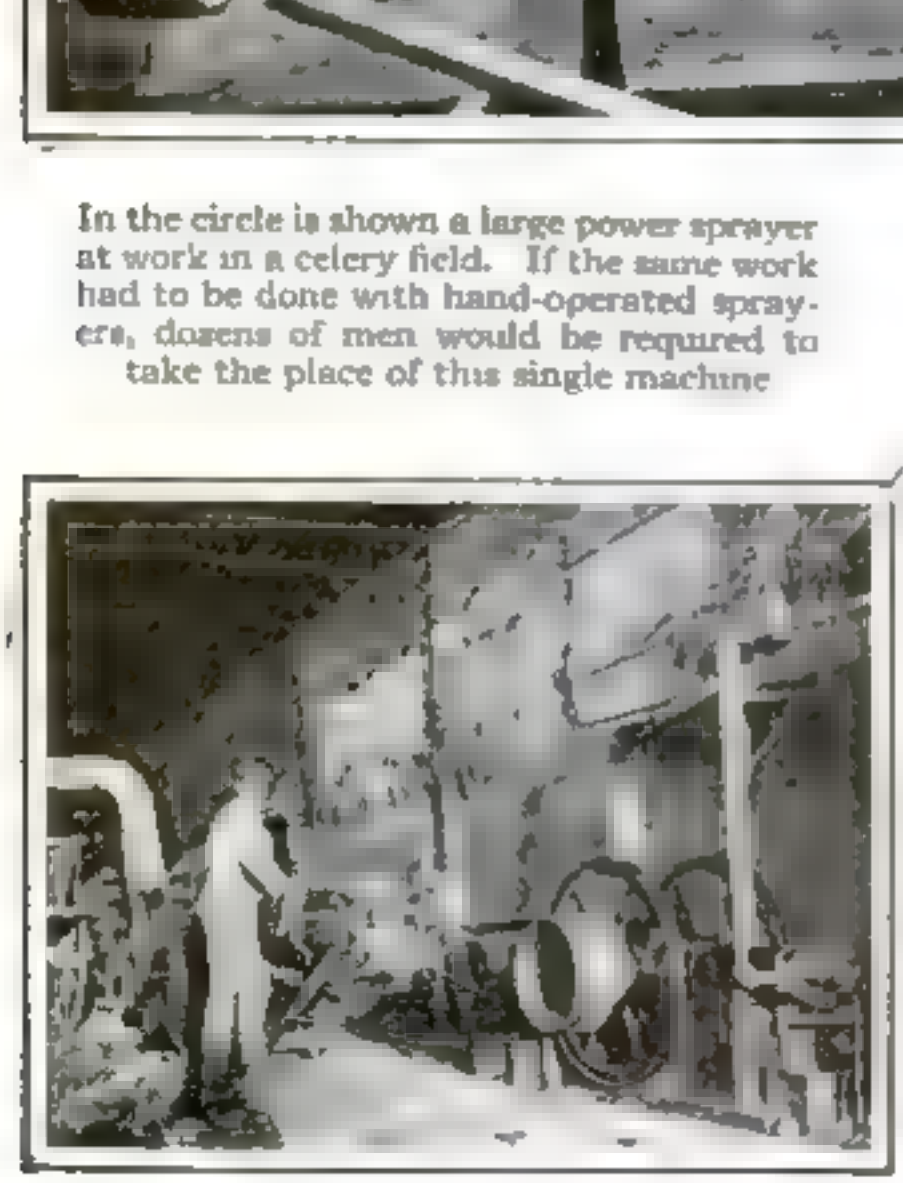
The picture to the left shows how a small engine can be employed to drive a conveyor and transport ice to an ice house. An engine is a very convenient thing to have whenever there is any sort of heavy hoisting to be done. Its power and ease of control make it splendidly adaptable for such work. The same engine has many other uses on the farm

Threshing with the aid of a portable engine. Below are two pictures which show how hay can be hauled with a motor under difficult conditions

A real gasoline horse guided by reins. It can go anywhere and never gets tired

Baling hay in the field. Below, is an arrangement for threshing and bagging peas by engine power. Contrast the horse with the engine. A horse tires out before the day is over; an engine is as fresh at night-fall as at dawn

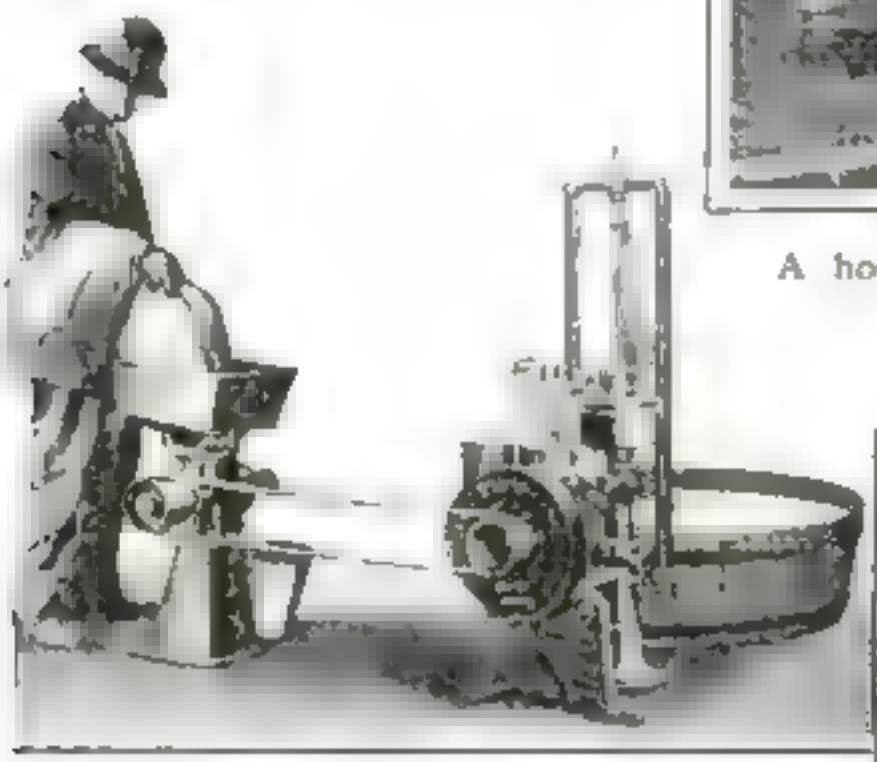
In the circle is shown a large power sprayer at work in a celery field. If the same work had to be done with hand-operated sprayers, dozens of men would be required to take the place of this single machine



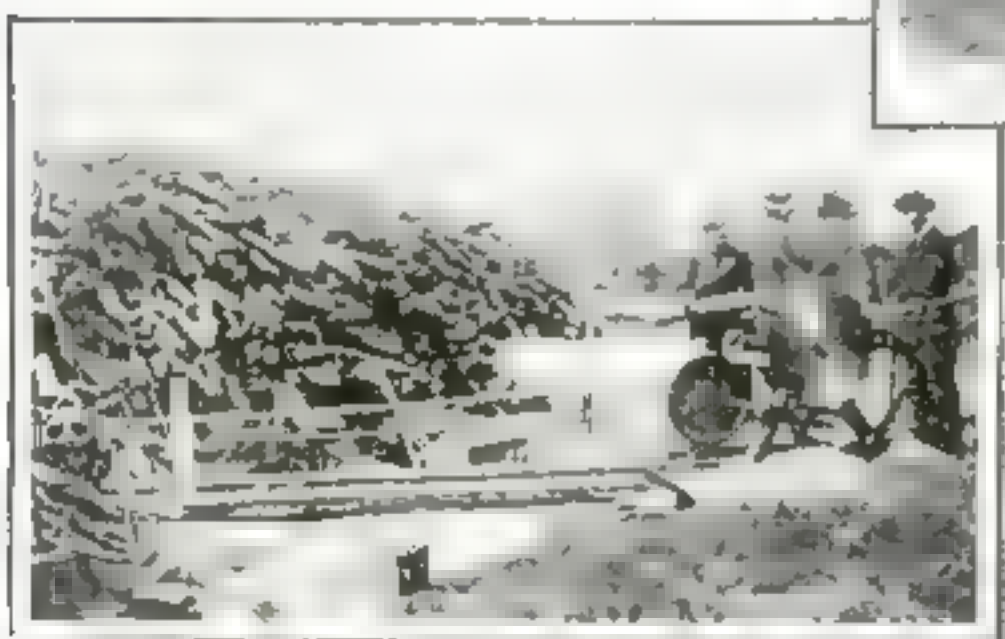
To the left is a silage cutter showing a connection with gasoline engine power for cutting corn silage inside the barn during any sort of weather

One engine running a grinder and pumping water at the same time. This particular outfit has many uses and has been especially designed to meet the requirements of the small farmer who cannot afford an expensive installation It is illustrated on other pages at some of its tasks. Water pumping and wood sawing were the first uses to which gasoline engines were put on the farm

A home-made gasoline bucket dredger at work digging drains on a farm



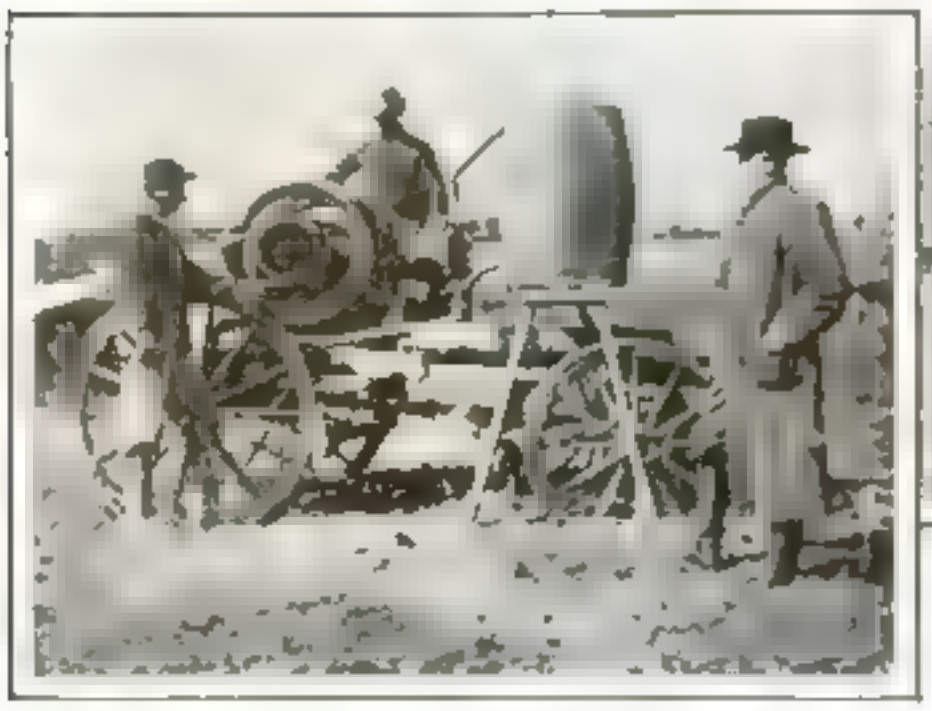
Below, an engine-driven wood sawing outfit at work



Using a traction engine to uproot trees

House moving *a la mode* with a traction engine

The man below is grinding mower blades with the aid of a gasoline engine. The youth who was formerly obliged to turn the handle of a grinder will welcome this machine with joy



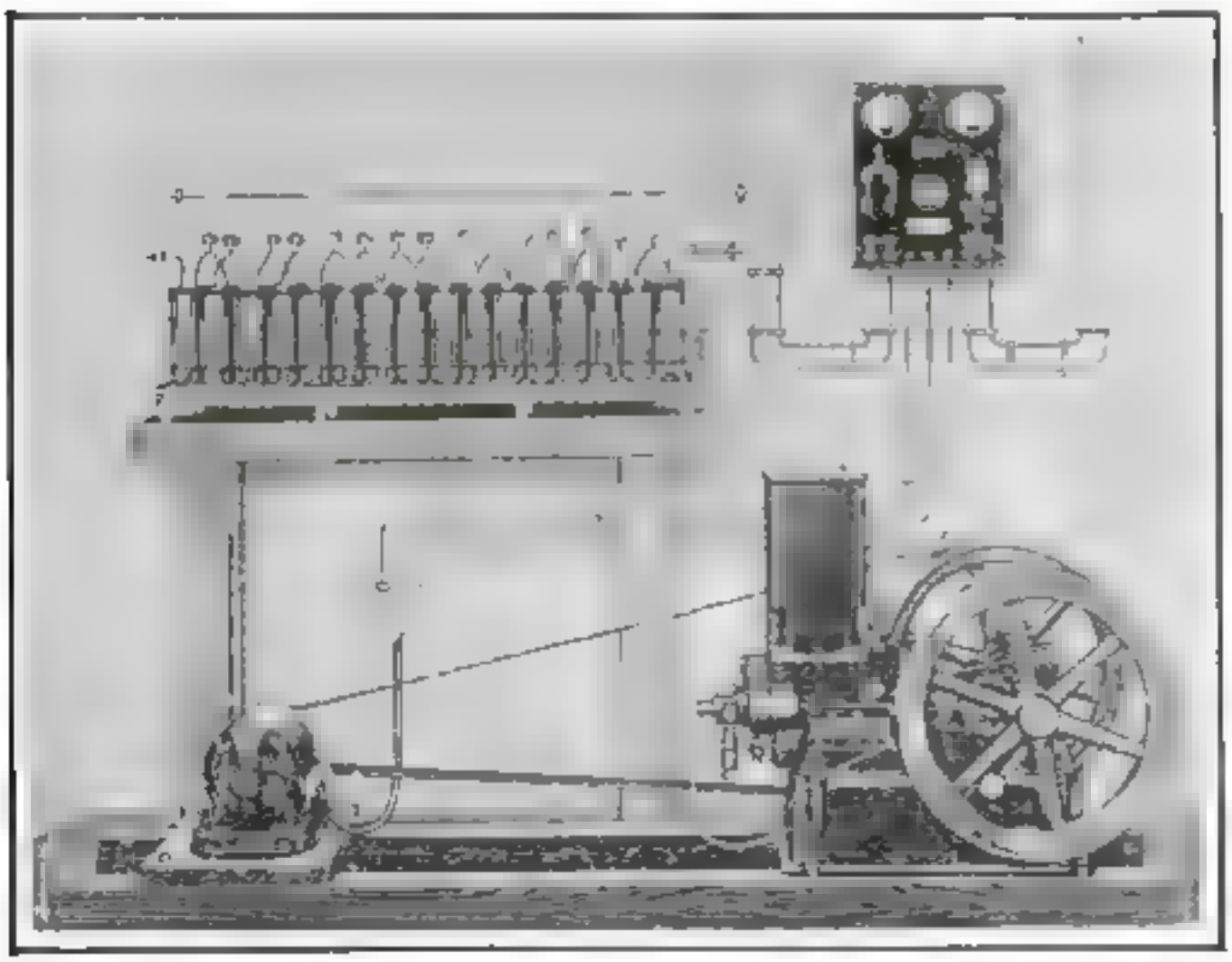
To the left, a five-horsepower gasoline engine mounted on an ordinary farm tractor and used for almost every form of farm work

A battery of sprayers is at work in the picture in the circle, spraying hops in British Columbia. The gasoline engine has become invaluable wherever spraying must be done over large areas

Driving a husker in Indiana with a portable engine is a great aid to the big western corn growers. The "hired hand" problem is brought a step nearer solution by it

A gasoline engine displaces the windmill

Operating a well pump with a little engine



To the left, an electric light installation for the small home. The improvements in engines and electrical generators have placed electricity within the farmer's easy reach. Good, safe illumination in the farm and stable more than pays for itself in the saving of time required for various duties, to say nothing of the elimination of risk from fire, always the terror of the dweller in the country

capacity of an engine of twelve to eighteen horse power. The corn husker and shredder, the silo filler (especially if fitted with a "blower," or pneumatic elevator), the big baling-press, etc., may easily utilize the power of the largest portables which are now obtainable.

Thus little engine, attached to mowers and binders, made possible the saving of thousands of bushels of grain in the West last summer. Heavy rains had made the ground soft, so that the power-driven mechanism was practically inoperative for lack of wheel-purchase. The binder was mounted on skids so that it could run over soggy ground almost as easily as over snow. A small gasoline engine drove the binding mechanism

Irrigation is almost a separate field, requiring a special installation, yet some of the smaller engines are pressed into service. In combination with hoists, spray pumps, balers and what-not, the utility of the gas engine becomes almost unlimited.

One great drawback to the universal popularity of the gas engine is the excessive competition and almost total lack of standardization — whether of price, rating, equipment, method of selling, or service to the customer after the sale.

An engine advertised at a low price may turn out to be of good value, but minus cooling tank, magneto, skid base, battery box, and other desirable accessories, while a higher apparent price may actually prove lower because equipment of good quality has been provided in full.

The tendency is toward better accessories, better workmanship, and better facilities for the furnishing of necessary repairs. Moreover, at least two influential organizations of technical men are working toward the standardization of power ratings and the use of stock sizes of bolts, nuts, pins and other easily obtainable parts.

A farm engine is not only far more easily maintained than is commonly realized, but it is extraordinarily inexpensive. The horse is an expensive luxury compared with a small motor. He must be fed regularly every day, whether he works or not; he is not as fresh in the afternoon as he was in the morning; he requires constant attention in order to keep him clean, to bed him properly and to minister to his physical wants. He may die at any moment. In fact, his working life is brief. Besides there is something almost pitiful in watching a horse doing heavy work.

Not one of these considerations applies to the inanimate, tireless, cheap engine. Its initial cost is less than that of a horse; it is never fatigued. It costs nothing when it is not in operation; it requires but little attention. The "hired man" problem is not so difficult to solve when a cheap source of power is at hand. A farmer wrote to an engine manufacturer and made the following interesting comparison:

"A man works at the rate of about one-tenth of a horse power. That is to say, the ordinary man in one hour does one-tenth horse power of work. In a day of ten hours, he does one horse power of work. If we consider a man's time to be worth at least $1.00 a day, it costs $1 00 to do one horse power of work by man power. A gasoline engine uses one pint of gasoline per horse power per hour. If we take gasoline at twenty cents a gallon, a pint costs two and one-half cents. The cost of one horse-power hour of work done by gasoline engines, therefore, is two and one-half cents. The cost for man power is one dollar."

A Machine to Pull up old Telegraph Poles

ONE of the most difficult tasks falling to the lot of the telephone or telegraph lineman is that of removing a pole which has been firmly embedded in the ground for a number of years. It is often necessary to dig the post out of its bed.

A Chicago concern has recently placed on the market a jack which is said to be able to accomplish this task in a few minutes. The device is very similar to an ordinary automobile jack, but is larger and many times as powerful. In the illustration is shown a pole which was fixed five feet in the ground, and which had been embedded for eight years. It took the jack nineteen minutes to pull the pole from the ground.

A chain, with a grab hook attached, is fixed to the lift of the jack, and is passed once about the pole. The lift extends two feet; then it may be lowered and the chain given a new grip. The capacity of the jack is fifteen tons, large enough, it is claimed, to uproot the most stubborn pole. The amount of time and labor saved by this machine are worth considering

A pole was embedded five feet in the ground. It was removed by a powerful jack in four and one-half minutes exactly

A Racing Car Built of Tires

A CLEVERLY constructed racing car, built of tires, tubes and cartons containing parts is shown in this photograph of a Houston, Texas, tire dealer's show window. The vehicle is composed mainly of outer cases, which range in size from twenty-eight by three up to thirty-seven by four and one half inches and are set upon a frame of light timbers. The seat is formed of cartons containing inner tubes; the dash is made of cardboard, on which are fastened patches and repair material tins to imitate speedometer and lighting systems; the exhaust is composed of a tube, stiffened within by cardboard to keep it rounded. In the seat is a driver who gives the final racing touch by gripping the famous Barney Oldfield cigar in the corner of his mouth. As yet, no one has tried to buy this car, though it will undoubtedly be sold piece by piece.

A show-window racer built of tires, tire boxes, and tire repair accessories

When these trees were young, fence boards were nailed to their trunks. The boards are now completely buried in the tree

A Tree Captures a Fence

MANY years ago a row of Irish poplar trees was used for the posts of a fence, and boards were nailed to the trees. The trunks of the trees, in the process of growing, gradually overlapped the boards, until now the boards are near the center of the trunks. Not needing the fence any longer, the owner sawed off the boards, the remnants of which still protrude from the trunks of the trees.

To Keep Automobiles off Railroad Tracks

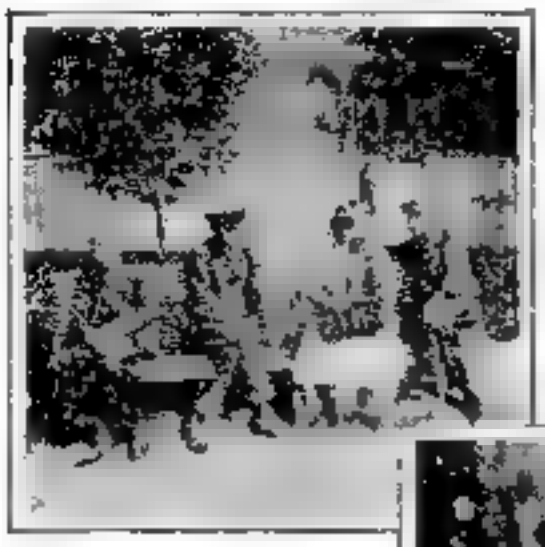
THE new long distance railroad signal has been brought about by the new conditions arising from the general use of the automobile. Chauffeurs are so frequently found driving through country which is new to them that they often find themselves on the tracks of a railroad line before they know it. The long distance signal was designed to give them sufficient warning of the proximity of the railroad tracks to enable them to be on the alert and to avoid accidents on the tracks. The new signal was designed by the officials of the Southern Pacific Railroad, and the first one was placed at the crossing of the main street in Tropico, Cal., but such excellent results attended the experimental installation that others are now being installed. The use of the new signal will be further extended.

The lines of the signal are such a departure from the typical railroad signal that it cannot help being observed by the wayfarer, either mounted or afoot. It consists of a tube of metal eight inches in diameter and two and a half feet long, mounted on a support, which, in this case is a piece of three-inch pipe. The pipe also offers accommodation for the electric wires which supply the current. The tube is painted black and is mounted in the direction of the road, so that the red light inside may be seen at a great distance before reaching the signal.

A red light inside the tube of this railway signal is visible for a great distance, and the disk attracts attention in the daytime

It Looks Like a Telescope, but It's Really a Camera

A CAMERA that can be used for taking photographs without the subject's knowledge, resembling in appearance a short telescope, has been brought out in Europe, in spite of the war's absorbing interest. A lens almost invisible is located in the side of the telescope so that the photographer, pointing what appears to be a telescope at some distant object, can get snapshots of objects that interest him, directly at right angles to his apparent line of vision.



This camera looks like a small telescope, but takes snapshots directly at right angles to the apparent line of vision of the photographer

The lens is equipped with an adjustable shutter, so that snapshots or time exposures can be made. For tourists traveling in foreign lands, such an equipment would be of considerable value, as natives often spoil photographs by unnatural posing and vacant staring, and this little camera would throw them off their guard. In Europe they call these contrivances "detective" cameras, probably because no detective ever carried them. The accompanying illustrations show snapshots obtained without the knowledge of those in the picture.

The new camera is especially valuable for securing natural pictures of persons who would pose and stare, or else run away, if a camera were pointed at them

What Is the Best Shade Tree in the United States?

THE prize for the largest shade tree in the United States was won by a sycamore tree in Worthington, Indiana, which the judges of the American Genetic Association found to have a circumference of forty-three feet, and a height of one hundred and fifty feet. This interesting incident calls attention to the fact that foresters are recommending the sycamore very strongly for city planting. They tell us that long experience with sycamores planted in city streets and on lawns has shown that the species is very well adapted to withstand the smoke, dust and gases so common in cities. Besides, the sycamore is very resistant to the attacks of insects and fungi, and grows rapidly. At ten years of age, a healthy sycamore is large enough for shade as well as for decorative purposes. Indeed, in the latter respect, it is not exceeded by any other Eastern species. Its mottled bark, its full, rounded crown, and its dense foliage, impart a very handsome and striking appearance to any lawns or boulevards which are fortunate enough to display these magnificent trees.

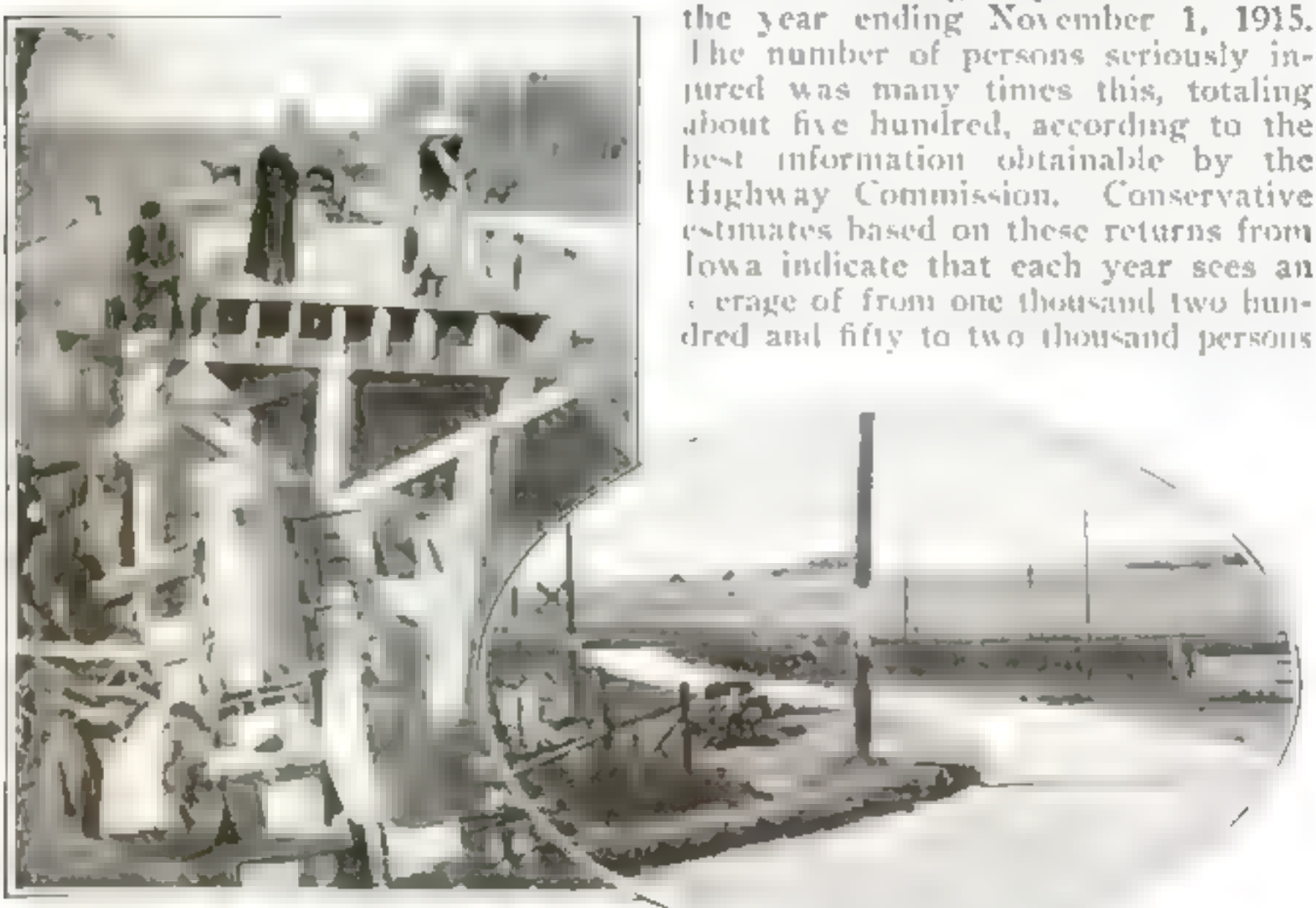
The sycamore ranks with the oak and hard maple as a decorative tree.

Perils of the Bad Road

By O. R. Geyer

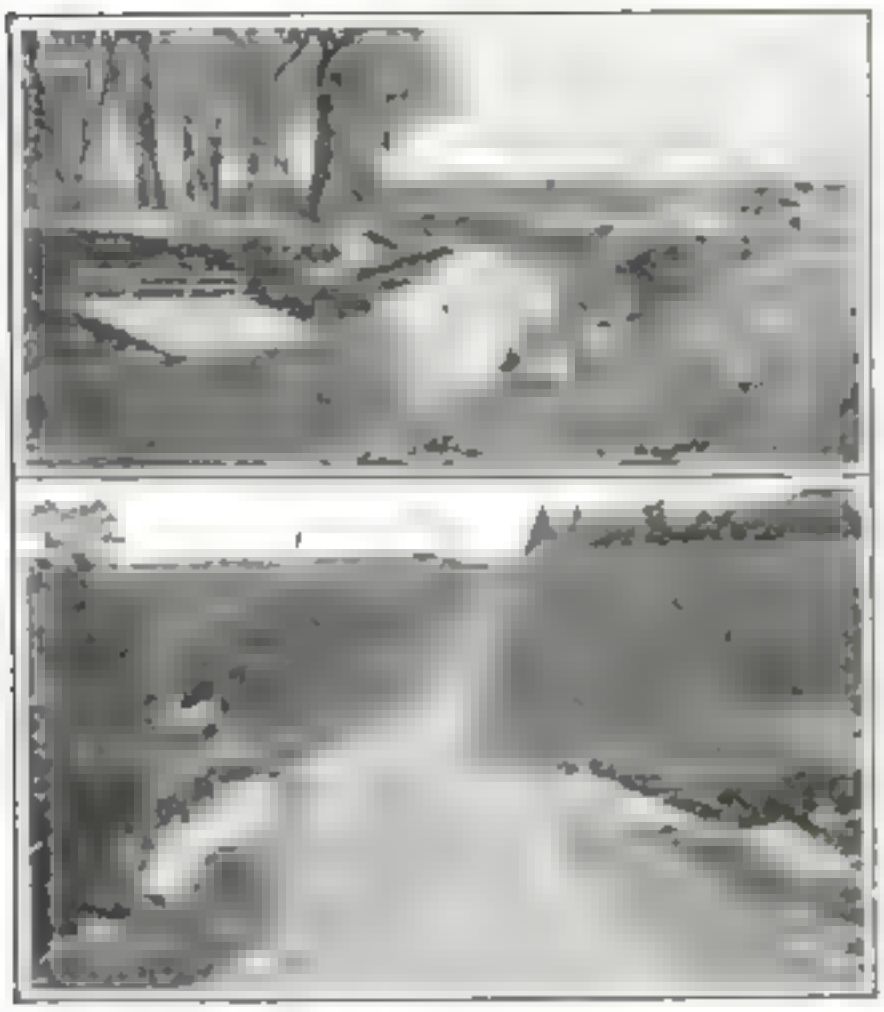
WITHIN the last few years Iowa has been brought face to face with the new problems of preventing the tremendnous loss of life on the state's highways. Every state in the Union is confronted with the same problem. Failure to exercise even the most important safety first principles is costing the lives of more than one thousand Americans each year, according to statistics compiled by road experts. This number is as large as the casualities in many a day's fighting in the world wide war. After much study, the State Highway Commission of Iowa is pushing vigorously a campaign for the building of permanent roads and bridges as a means of saving many lives.

The majority of these accidents could have been prevented with the exercise of a little more care, but since the average American is in too much of a hurry to protect his own life and the lives of others, the state must help him. Iowa lost seventy-five of her citizens through accidents which occurred on the highways of the state in the year ending November 1, 1915. The number of persons seriously injured was many times this, totaling about five hundred, according to the best information obtainable by the Highway Commission. Conservative estimates based on these returns from Iowa indicate that each year sees an average of from one thousand two hundred and fifty to two thousand persons killed and more than five thousand seriously injured in accidents on the highways. This means that in each state of the Union more than twenty-five persons meet death on the highways in a year's time.



Grade crossings and unsafe bridges constitute two of the gravest perils of the road, although the danger of unsafe bridges is more important in those districts where heavy farm machinery is moved than it is in the Eastern States. The illustration on the left shows a fatal accident caused by a farm tractor and trailer falling through a wooden trestle, resulting in two deaths. On the right is a typical grade crossing, with a dangerous sharp curve, in approaching which the driver's back is toward many approaching trains

This loss of life and limb and the resultant destruction of property is



Such bridges as these are responsible for many fatalities. When the spring rains cause the rivers to rise, these light bridges are carried away, or so undermined that they cannot support the weight of an ordinary automobile

costing the country about twenty-five million dollars a year, a sum sufficient to build many miles of paved roads—an estimate based on an allowance of ten thousand dollars as the value of a human life. The loss in Iowa, economic and real, is more than one million dollars.

The greatest contributing factors to this huge death list are bad roads and bridges, speeding and reckless driving. The Iowa Highway Commission, realizing that it cannot put a stop to reckless driving and speeding, is working on a plan to make the highways as safe as possible, and has succeeded in bringing about a material reduction in the number of accidents. Still, the commission realizes that even the safest roads will not make speeding entirely safe. It has begun a campaign against reckless driving

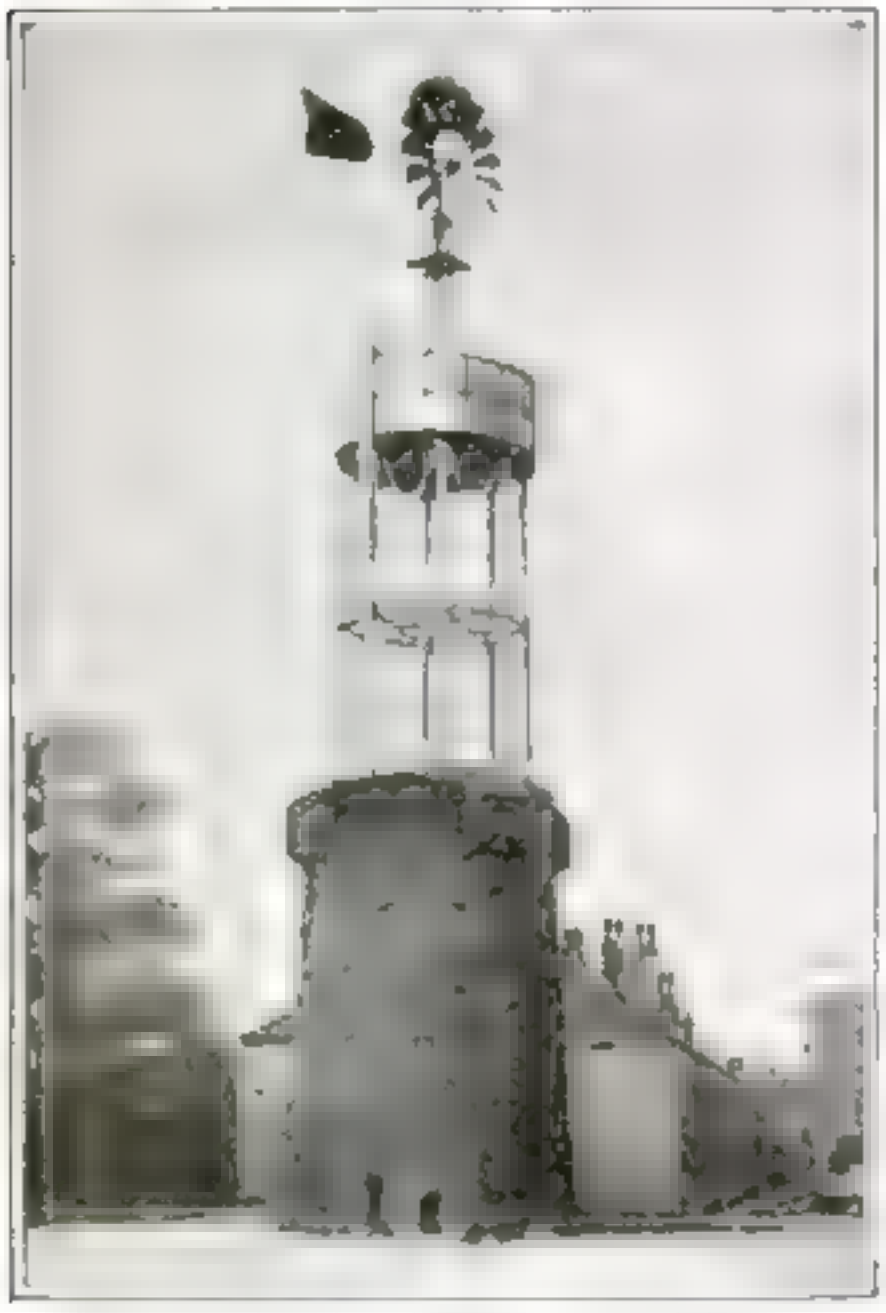
Second in the list comes the grade railroad crossing, which takes an unusually heavy toll of lives and mangled limbs in a year's time. There are eight thousand six hundred and seventy-six railroad crossings in Iowa, and of this number nine hundred have been classed as a constant menace to life by the commission. The work of removing these dangerous crossings was taken up in a serious manner more than a year ago, and at the present time nearly one hundred of the nine hundred crossings are scheduled for improvement in 1916. Improvements were completed on eighteen crossings during 1915.

The task of removing and relocating these bad crossings is a stupenduous one, the average cost of each change ordered so far being four thousand four hundred and forty-seven dollars. At this rate it would cost Iowa nearly twenty million dollars as her share of the improvement. The railroads must pay a sum equally as large, too, before these nine hundred crossings are made safe for ordinary travel. The question as to whether these costly improvements are worth while is best answer-

Another view of the tractor and trailer which fell through a wooden trestle. The driver of the machine and his assistant died on the way to the hospital

ed by the reports for the year 1914, which show that fifty Iowans were killed on railroad crossings of this sort. The death toll from this source for 1915 has been almost as large.

Immediately following a fatal accident, when public opinion demands action on the part of the local authorities, plan and estimates of cost are worked out, and a tentative adjustment of the cost between the county and railroad is made. In the majority of cases the railroads have been willing



This old fort has been converted into a water tower, and is saving much expense to the town

to co-operate with the state in removing these sources of danger from the country highways. One railroad in particular relocated eleven dangerous crossings in one county.

Dangerous turns in overhead crossings, bridges undermined during flood seasons, sharp turns in roads, "chuck" holes, ditches alongside roads, weeds and other obstructions on roads, unguarded bridges, speeding on slippery roads, reckless driving at night, "short" culverts, steep embankments, neglect in placing warning signs or barricading dangerous places are some of the sources of danger the traveler in the country must encounter almost every day.

The loss of more than 125 Iowans in the last two years has not been without some beneficial results, as a demand for the building of permanent roads has been crystalized as the result of these sacrifices. It has been rather a costly manner in which to awaken the public to the need of these changes, however.

Sprinkling Streets with the Aid of an old Fort

ONE of the many Martello towers or forts found around the coast in the Channel Islands has been put to a novel use. These buildings lie idle for the most part, having been built over a hundred years ago, and are now useless from a military point of view.

In Jersey Island, however, a use has been found for one of these towers. It now forms the base of a water tank used for street-sprinkling

A windmill pumps water into the tank, thus saving considerable expense formerly incurred when water was taken from the water company's mains.

Signal Lights for Traveling Cranes

WORKMEN employed in shops where a traveling crane is used are constantly on guard to see whether the crane is approaching them. This consumes a considerable amount of time, which, when multiplied by all the workmen so occupied in looking up at the crane, totals up to a formidable loss. An Ohio firm has placed on the market a device which is designed to warn the workmen, by means of red and green lights on the crane, whether the latter is coming toward, or moving away, from them. When the crane approaches the observer, the red light automatically lights, and when it departs from the observer, a green light gives the safety signal. The device has the advantage over warning gongs, which merely attract without telling the direction in which the crane is moving.

This pneumatic chisel is installed in the sculptor's studio, and greatly simplifies his work

The Sculptor's Use of a Pneumatic Chisel for Artistic Carving

SINCE the very beginning of sculpture, the greatest difficulty encountered by the creator has been in the matter of outlining the marble. The only method known, until quite recently, was the tedious process of carving with mallet and chisel and this was not only laborious, but awkward as well, for only one hand was left free to guide the chisel, the other being required to hold the statuary in place. Naturally the result was often crude and imperfect because of the limited strength of the one hand.

Hans Schuler, the well-known Baltimore sculptor, was among the pioneers of those who broke away from this confining and hampering method. He installed in his studio what is known as a "pneumatic chisel"—literally a chisel operated by air. This is nothing more than the old chisel employed by the stone-cutter and carver. The device greatly simplifies the work and gives infinitely wider scope to the artist. It leaves both hands free.

The chisel, in shape and size exactly like that of any ordinary stone-cutter's, is driven by compressed air at a pressure of seventy-seven pounds a square inch, operating through a long flexible tube, the air being compressed in a large tank by means of an electric motor. The chisel is pounded against the stone as if hit by a mallet, due to the air passing through the tube.

It is amazing that the application of this long-known invention did not occur to sculptors several decades ago, but the efficacy of its use is well illustrated when it is realized that such eminent sculptors as Lorado Taft, Hans Schuler, and Edward Berge make use of it exclusively. Of course it can be employed only in the rough modeling and in large figures, all of the finer and finishing work having to be done by hand as before. The amount of labor saved, however, is inestimable.

An Automobile Road Sign and a Map Combined

THE Automobile Club of Southern California has installed guide signs at different points, which give a complete diagram of the good roads as well as the distances to the various towns and highways from that immediate district. The sign itself is complete and thus saves the motorist the trouble of consulting his own map, if he should have one with him. The point at which the sign is placed is designated on the diagram by a three-quarter red disk.

Guides of this type are a great aid to the motoring public and save any amount of annoyances and inconveniences due to inaccurate directions so often picked up on the roadside.

A sign post that is a boon to the motorist

Forest Rangers Must Fight Snakes as Well as Fires

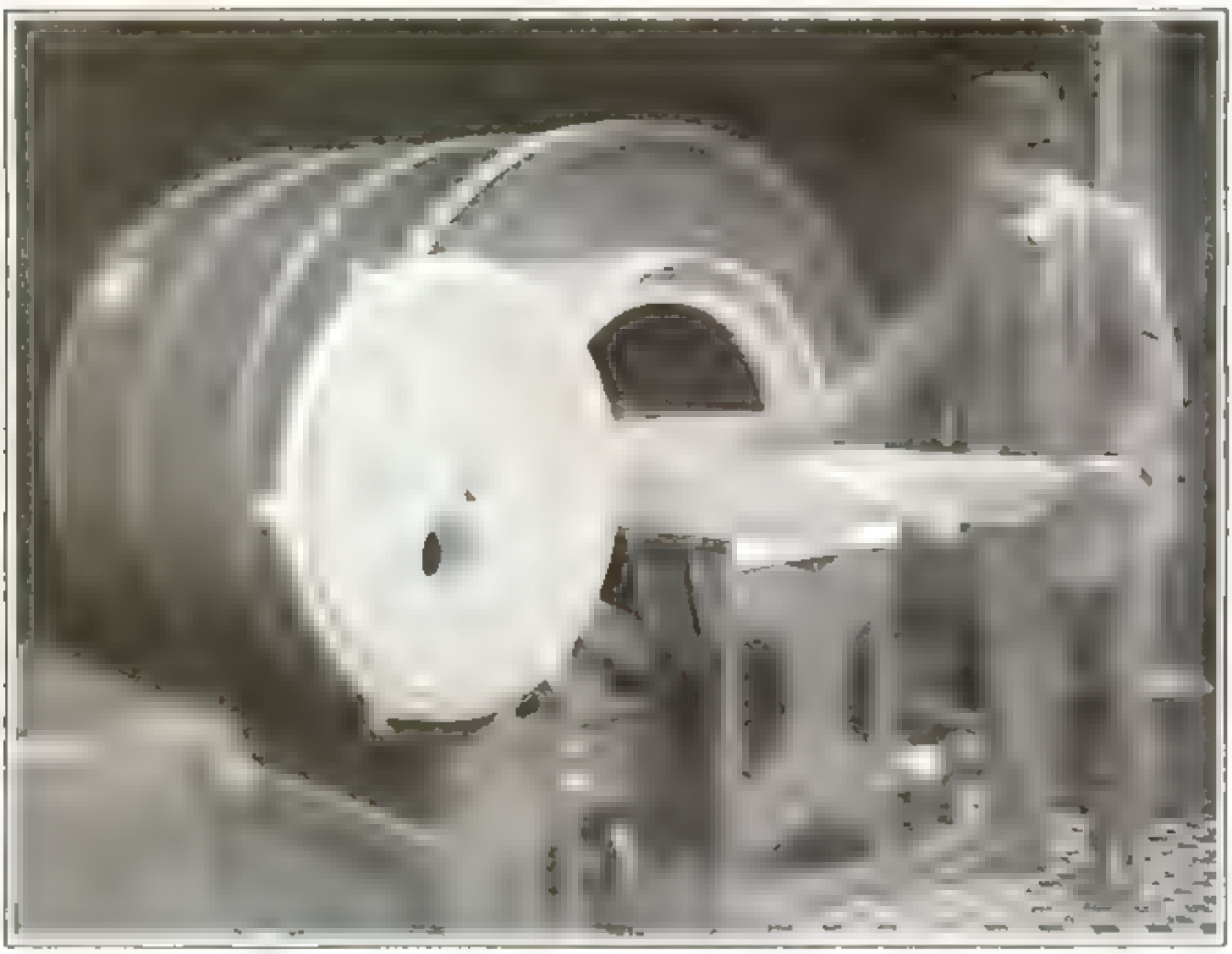
THE Forest Service is on the war path against rattlesnakes in the national forests. Many forest rangers have been bitten by these venomous snakes from time to time, but the attention of the forest service was sharply called to the necessity for the extinction of rattlesnakes by an episode which occurred during a recent forest fire.

Several fires broke out in the Shasta National Forest, and a force of men was called to subdue it. After the fire was thought to be extinguished and the men were withdrawn it was discovered that one blaze had broken out again. A squad of men who returned to the scene ran into a section of brush that seemed literally alive with rattlesnakes. Six hours were spent in fighting the snakes before it was possible to enter the forest, and in the affray several men were bitten

Arrangements are now being completed for the arming of forest guards and fire fighters against snake bites. The weapon to be given out consists of a small combination tool containing a sharp lancet and a receptacle to hold permanganate of potash, which is declared to be the best antidote for snake bite.

Making Butter by the Barrel.

DAIRY work is receiving much attention in England during the war. The thousands of wounded and convalescent soldiers in the hospitals throughout the British Isles consume tons of eggs, milk and butter every day, and it is extremely important that all of this material be of the very best. The accompanying illustration shows a monster churn which can make and wash six hundred pounds of butter at a single operation.



This monster churn makes and washes six hundred pounds of butter at a single operation, and is exceeding valuable at this time in English hospitals, where wounded soldiers consume large quantities of dairy products by the orders of their doctors

This merry-go-round furnishes great enjoyment for bathers who must have water sports of a more or less reckless variety It is operated by an electric motor, and splashes the bathers in the water as it whirls them about

A Merry-Go-Round in the Water.

FOR the entertainment of its patrons, who enjoy water sports of a more or less reckless variety, a recreation park on Lake Erie near Cleveland, Ohio, installed last summer a revolving mechanism for bathers which, in the form of pleasure it offers closely resembles the familiar merry-go-round, or carousal, of the state fair

An iron framework similar in design to an oil well derrick supports revolving arms to the outer ends of which cables are attached· The bathers swing and splash in the water as the arms revolve. An electric motor on a platform a few feet above water level is connected by gears to an upright rod through which power to revolve the arms is applied

Motion Pictures on the Firing Line

A LETTER from the War Front in Europe gives an interesting description for a motion picture theater near the firing line in Flanders. This theater is operated by several British army officers to provide relaxation and amusement for the troops when off active duty.

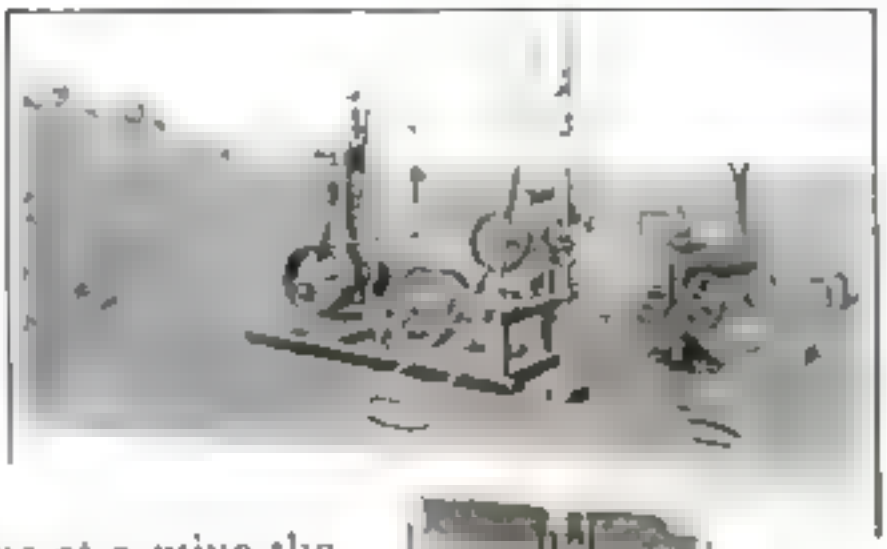
There are usually two performances each evening, with a four reel program. The soldiers pay twelve cents admission, while the officers are charged a double amount. The expenses are very low, since most of the work is voluntary, and all profits are devoted to charity. The operator and pianist were both formerly employed in the same capacity at motion picture theaters in London. The power for the lights and the machine is obtained by fastening a dynamo to an automobile.

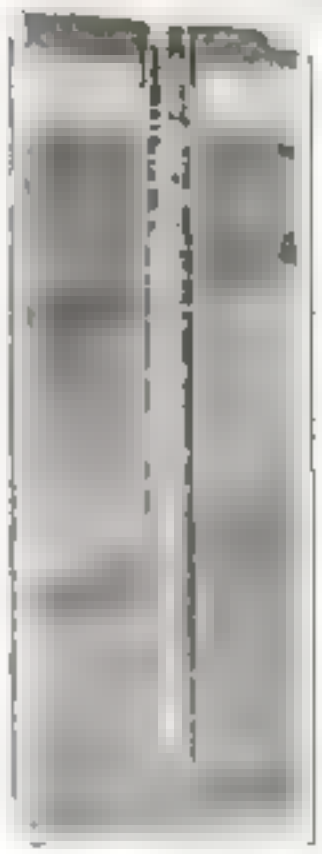
At first all the films were obtained from Paris, but the cost was so high that the theater was being operated at a loss. The lieutenant in charge of the theater then went to London to attempt to rent the films at a more reasonable price. When he had explained his desires to the officials of a prominent motion picture concern he was offered sixteen thousand feet of film monthly until their supply was exhausted.

It is said that it is by no means unusual to hear the reports of shells while the performance is progressing, as the firing line is but a short distance away.

Inspecting the Inside of the Earth

IN mining for coal or metals, operators must know a number of things about their claims in advance unless they are out-and-out gamblers. Before starting operations at a mine the thickness, extent and richness of the vein must be estimated in order to determine whether the mine can be worked profitably. The depth of the vein from the surface, the dip or angle at which it lies and the nature of the materials that will be encountered before reaching paying values, are also factors of the greatest importance. In a word, the mine operator must have a good idea of the "lay of the land" in advance, or he may be doomed to failure from the start.





How the drill samples the earth through which the boring is made

All of these questions are easily answered in advance by means of core drills. Think of the way a corer takes out the heart of an apple and you have the main idea of the core drill. These drills have been used for taking samples out of the earth at varying depths from a few yards to several thousand feet. The speed of drilling, of course, depends upon the size of the core and the hardness of the rock, but the average is probably between two and four feet per hour. Several typical cores are illustrated.

Piles of cores from the drill. Here is a record of the contents of the earth for hundreds of feet below the surface

Figure 1 illustrates, in section, a core drill penetrating loose material composed of soft rock and earth. Here the cutting bit is shown with several sharp cutting edges, and the core barrel is about three-quarters filled with the different kinds of rock that have been penetrated.

Figure 2 shows a core drill employing a steel shot bit, which type is used for cutting hard, solid rock. The rod *F* extending to the surface of the ground imparts a rotary motion to the cutting tool. As the drill sinks deeper and deeper, this rod is extended correspondingly by screwing pieces into it at the top. The rod is hollow and through it are fed water and very hard small steel shot. The shot settles, entering the diagonal slot near the bottom of the bit which feeds it beneath the rotating bit, as shown at *L*. Here the weight of the drill, combined with the abrasive qualities of the shot, rapidly wears away the rock and permits the cutter to settle around the core.

While the core is being made, the cuttings are washed upwards by the stream of water and settle in the receptacle *B*, which is known as a calyx. This gives an additional record, in inverse order, of the rock and earth penetrated, the materials being in pulverized form, suitable for assay purposes. Figure 3 illustrates this point and also shows how the core is broken preparatory to extracting a piece. For this purpose, pebbles are fed into the drill in place of the shot. They jam around the core near the bottom and break it off as the drill is rotated. This wedged material also holds the core in place while the drill is being raised to the surface.

These drills, while sinking deep into the ground, constantly send up samples of the earth for examination. They are in the form of solid rods, large or small (as here)

With several soundings thus made in different parts of a property and accurate records kept of the material encountered at different depths, it is a simple matter to map the various underlying strata and eliminate absolutely all guesswork from subsequent operations.

The Size of a Railway Station

LOVERS of statistics will be interested to know that in the concourse of the express level of the Grand Central Station, New York, the old City Hall of that city could be placed with twenty-eight feet to spare at either end and with one foot clear on each side. The top of the statue on the City Hall would be nearly fifteen feet under the ceiling. The number of passengers handled annually at this great station increased from fifteen million, seven hundred and fifty thousand in 1903 to twenty million, eight hundred thousand in 1914. In 1905, nine hundred and eighty-two thousand cars entered the station, and in 1914 there were one million, one hundred and twenty-six thousand. Fewer trains, however, are entering the station, for in 1905 there were two hundred and seven thousand eight hundred trains, while in 1914 there were but one hundred and eighty-two thousand five hundred. This decrease is due to the fact that more cars are hauled by the electric locomotives in one train than were hauled by the steam locomotives, and therefore fewer trains are required than heretofore.

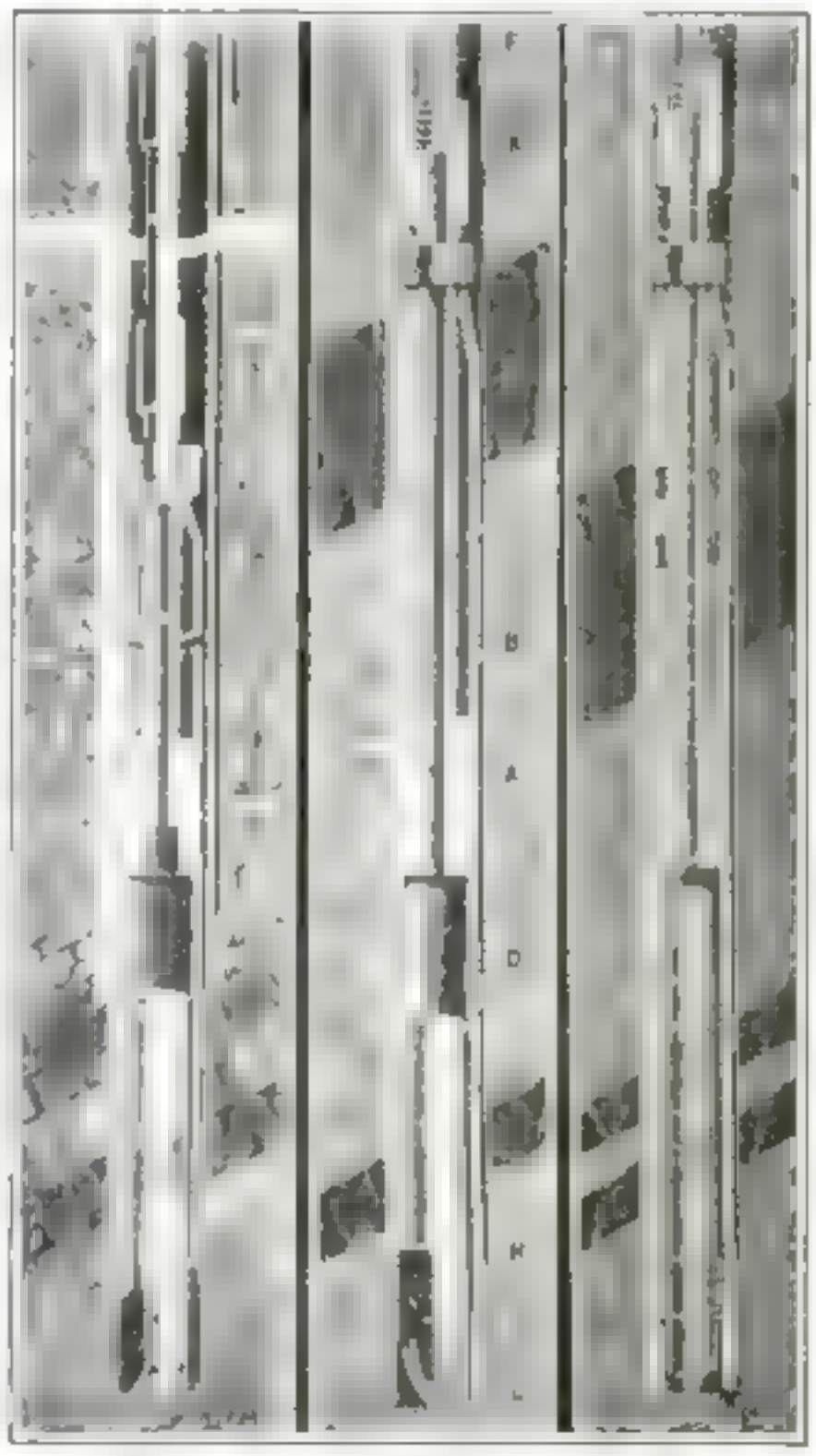


Fig. 1 Fig. 2 Fig. 3

Typical cores and how they are procured. Fig. 1 is working through loose material, with a sharp-pointed drill. Fig. 2 is using steel shot to cut through hard rock. Fig. 3 shows the use of water in cutting, also how pebbles are used to break and hold the core preparatory to stopping the work

Power from a Floating Water Power Plant

FARMERS who have small streams running through their places are showing much interest in the portable and self-contained power plant which has been designed and patented by A. G. Watkins of Philadelphia. The apparatus can be used wherever water moves at the rate of two miles an hour, which is less than that of the average stream. The plant consists of two triangular floats fastened together by iron rods to form a channel of decreasing width. A water wheel is mounted in the narrow part. Between the floats and beneath the water there is an adjustable platform, set at a slight angle, so that, together with the floats, a wide-mouthed opening is formed, decreasing in its dimensions in three directions toward the wheel. This has the effect of increasing the volume of water passing through the narrow opening and acting on the blades of the wheel.

The float on one side houses a motor with a series of gear-wheels which multiply the power to such a degree that a one-half horse power dynamo is effectively driven. The other side of the float contains a pump, and thus water or power may be secured as desired. The float is anchored to a tree or any other convenient object. Where more power is wanted several of these devices can be tied up one behind the other.

The plant shown is the first which has been demonstrated by the inventor. It is shown on the surface of Carrol Creek at Frederick, Md. A line was run to the bridge appearing in the distance, where twenty incandescent lamps of sixteen candlepower each were operated.

One of these plants will soon be in operation at St. Petersburg, Fla. It is said that the operation of the power plant in cold weather is not interfered with by ice for the reason that the motion of the water in the passage between the two floats prevents freezing.

Two triangular floats support the water wheel, which derives power from any stream flowing at a rate even as low as two miles an hour

How to Make Knots, Ties, Hitches and Bends

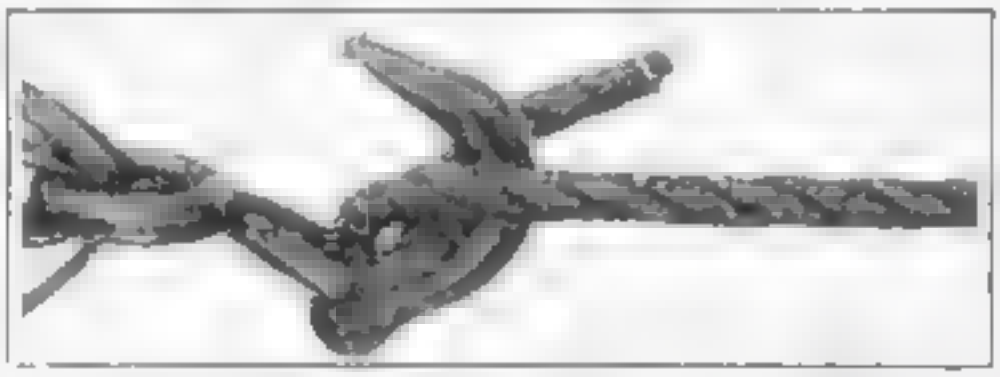
The Timber Hitch, a safe and simple knot usually employed in holding poles and booms. The turns in the loose end must be carefully made

The Double Bowline is used when the end cannot be used, and when a loop is desired in the bight

The Single Bowline is one of the most important of all the hitches. It is very safe and will not slip or jam

The Timber and Half Hitch. Much the same as the Timber Hitch with the addition of a half hitch to avoid any danger of the rope's rolling

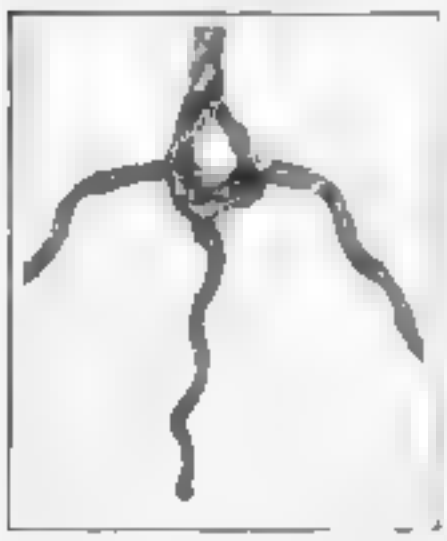
The Square or Reef Knot is one of the safest ties, but care should be taken to avoid a "granny"



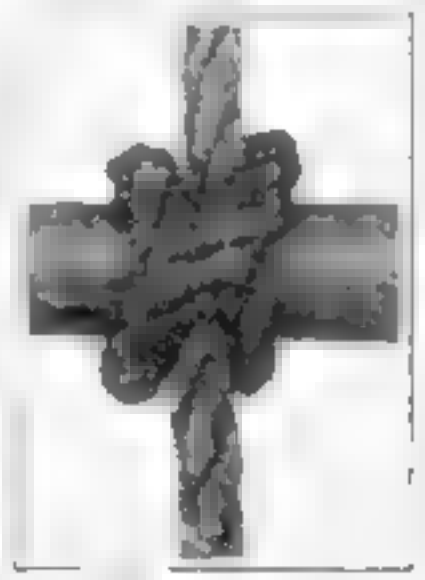
The Blackwell Hitch, while safe for light loads, is likely to part under heavy strains

A "safety-first" tie, the Cat's Paw. This hitch will sustain heavy loads, and is most used for that reason

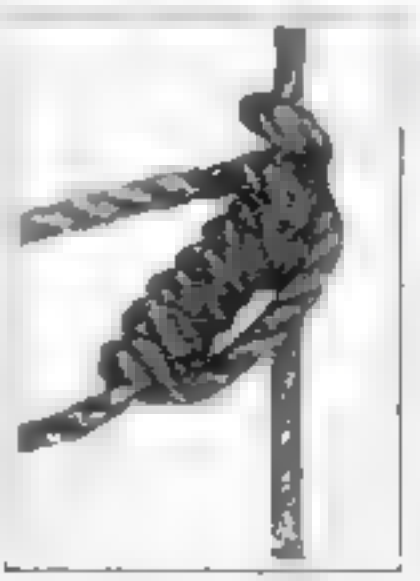
When the rope is too long, it may be shortened by the use of this knot, the Sheepshank



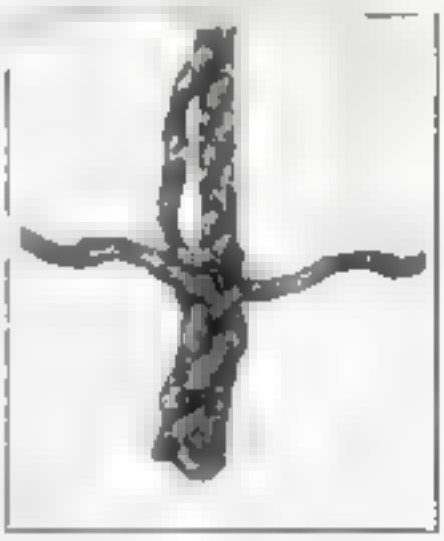
The first operation in preventing the dead end of a rope from ravelling



The Clove Hitch is a very safe knot, and may be handled very quickly



The Stopper Hitch is used to hold the strain in the fall line of blocks



The second operation in preventing the dead end of a rope from ravelling

Brushing Your Teeth; There Is a Right and a Wrong Way

IF people as a whole were aware of the importance that a toothbrush plays in the healthful happiness of their entire body more attention would be paid to this perfunctory daily exercise. The soberness of this fact is perhaps a trifle more evident when it is mentioned that mouth infection is now known to be the source of numerous diseases that cause chronic sickness and eventually death. Looking upon the situation from the opposite side, it is equally true that mouth and

The teeth and gums should be scrubbed with a circular motion five or six times in succession

teeth cleansing is the chief means of preventing these diseases, and in many instances, curing them.

A Philadelphia physician, who has gone more deeply than usual into this question, points out that mouth washes are of no value in the presence of bacterial masses, unless these are removed once a day at least. In other words, the mouth should be thoroughly scrubbed daily.

This physician lays even more stress

The tooth brush should be small and the bristles short. The upper brush is similar to those usually bought. The lower brush is correct

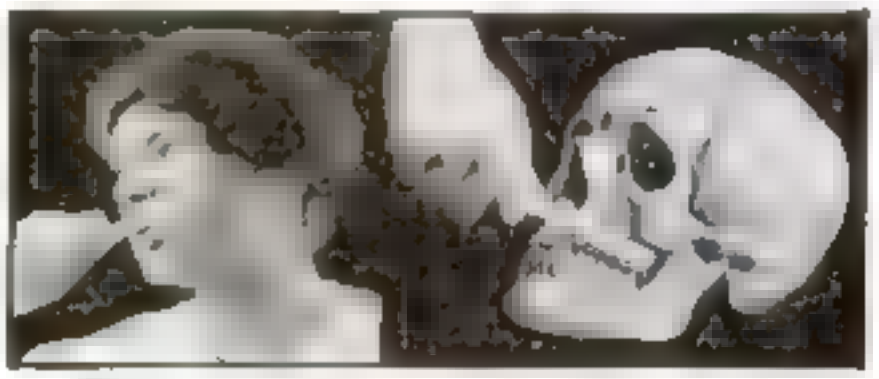
upon the correct use of the toothbrush. He has calculated the antiseptic and

The spaces between the teeth should first be carefully cleaned with dental floss

curative results brought about by the the use of the toothbrush on a mathematical basis.

For example, the tooth brush being usually two inches long, generally reduces the movement of the bristles to a half inch, which is almost all taken up by springing and pivoting, so that the actual friction amounts to very little, if anything.

Therefore, considering that friction is a highly desirable factor, the ideal



It is most important that the circular brushing should extend as far back in the mouth as possible

tooth brush is one not over one inch and a quarter long with bristles not over a quarter of an inch in length. Bristles of this length will necessarily be stiff, but if the gums are soft and inflamed, a brisk rubbing is the best thing in the world for them, and will, in the course of a week or two, bring them back to a state of health again. The fact that the inflamed gums become sorer than usual during the first few days is an indication of self-poisoning, or autoinoculation, a condition and a result that should not exist in an otherwise healthy person.

Care should be taken to follow the curve of the gum with the entire face of the tooth-brush

Floss silk, so this physician has noted, is another great corrective for ailing teeth. The silk should be passed between teeth, across gums and drawn rapidly, even roughly. The discomfort may be slight, but it is sufficient to cause most people to avoid the practice, although they would perhaps be somewhat more enthusiastic towards this particular tooth cleanser if they knew that it would help greatly towards avoiding gout, rheumatism, valvular heart disease and ulcer of the stomach.

Concerning the general mechanics of tooth brushing, there are three important actions to be borne in mind. The first is the rotary motion, whereby all the gums and the teeth in front of the second molars are cleansed by a vigorous whirling motion. Second, the drawing motion wherin the middle of the brush is placed behind the wisdom teeth and drawn vigorously across the gums. Third, the drawing motion wherein the brush is placed back of the last molar and drawn sharply forward along the gum margins and the teeth.

It may be mentioned that healthy gums can stand the same vigorous friction as can be borne with impunity by the finger nails.

The middle bristles of the brush should be placed at the back of the third upper molar and drawn briskly forward along the gum margin

Hard-Pressed Germany Invents New Foods

POTATO sausages are being made in Germany which are said to taste a great deal like blood sausages, and are not a great deal lower in food value. The price of the potato sausages (called also K-sausages) is much less than the blood sausages.

It was found possible in Germany to purify bacteria-carrying oysters by allowing a stream of pure, fresh, filtered sea-water to run over them, in tanks, for four or five days. No sickness resulted from eating these oysters.

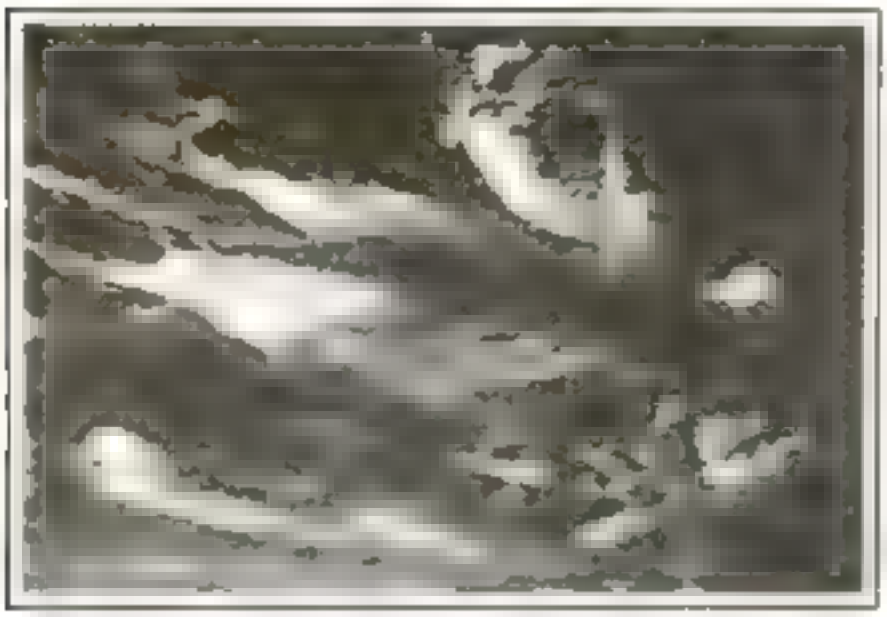
Study of the milk marketed in Zittau, Germany, up to the present time of the war shows that scarcity of good fodder for the cattle does not decrease the fat content of the milk, but only the quantity of the milk.

This movement will clean the backs of the teeth which are too often neglected

In Germany the comparative quality of the milk can be decided by the use of certain bacteria. Five are used, called respectively and alarmingly the "Danish streptococci," "Jaroslawer diplococci," "Guntherschen diplococci," "Russian lactic acid streptococci" and "Bacillus bulgaricus." The Danish streptococci can live only in fairly good milk, the Jaroslawer diplococci in worse, and so on down the list until we reach the Bacillus bulgaricus, which is tough enough to live in very bad milk. However, there is milk so bad that not even the accommodating Bacillus bulgaricus can live in it

An elderberry wine is being made in Germany which is so like grape wine that it can easily be used as an adulterant of grape wine. It can be detected by chemical analysis, however

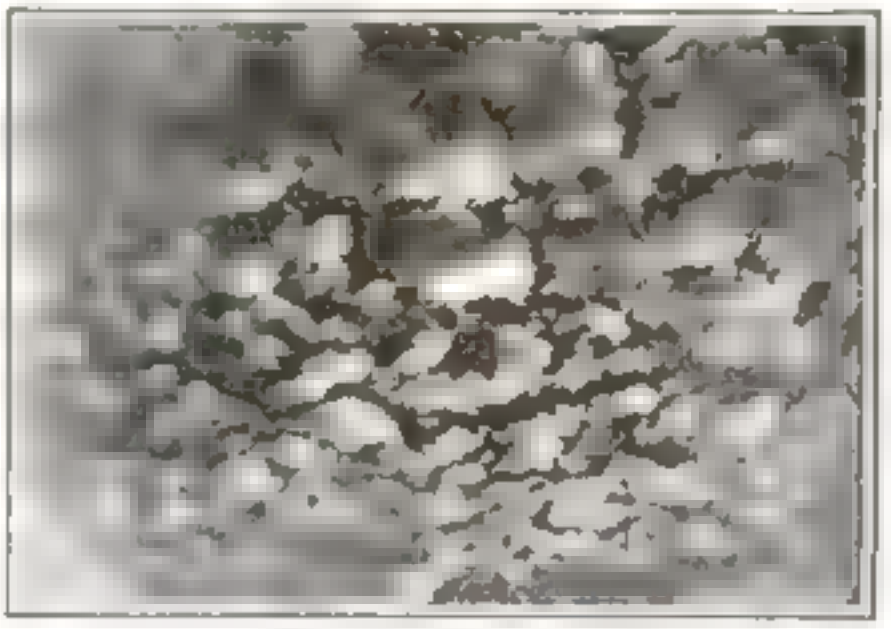
New methods for determining husk residue in meals and flours have to be used, since the German war orders to grind more of the husk into the flours.



Cirrus clouds

Cirrus passing into Cirro stratus

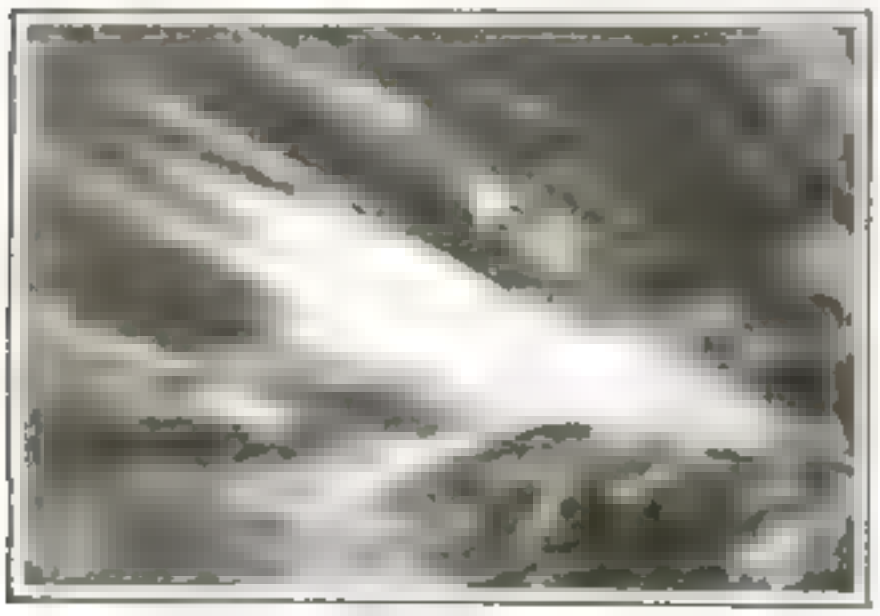
Cirrus clouds



Alto-cumulus clouds

Cirrus clouds

Mammato-cumulus or "pocky" cloud



"Mare's tail" Cirrus clouds

A small form of Alto-cumulus

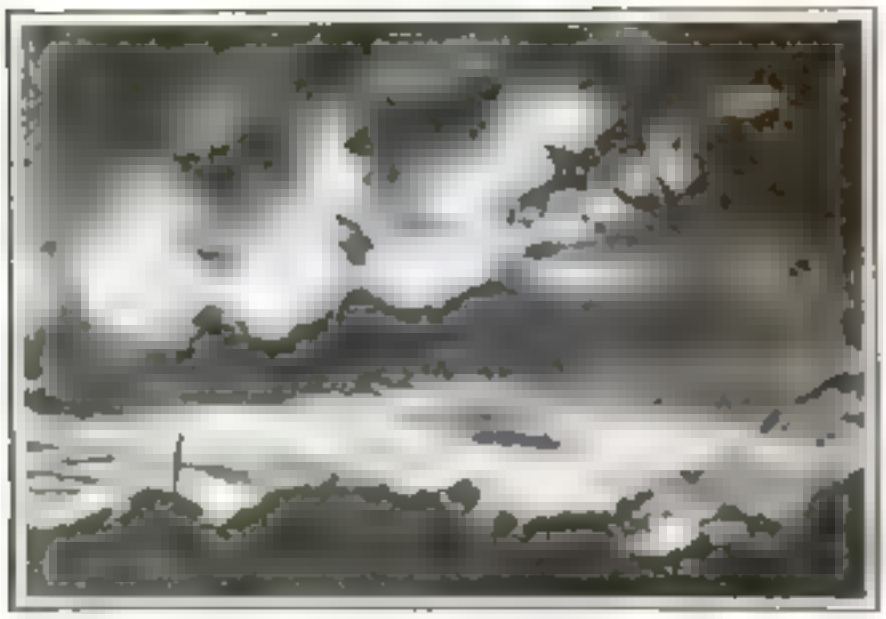
A Journey to Cloudland

A majestic cumulus, passing into cumulus-nimbus. A very beautiful and common type

THE clouds, like the stars, are among those common objects of Nature upon which men look, for the most part, with unseeing eyes. Some aspects of the clouds do, indeed, force themselves upon our attention—chiefly those that denote the imminence of a storm—but few of us realize to the full the beauty and scientific interest of the vapory pageant that is continually sweeping across our skies. Strange to say, many artists, skilled in painting landscapes, are unable to paint plausible sky scenes. About half a century ago an English painter, Elijah Walton, published a book (now almost forgotten) in which he pointed out that the great majority of out-door pictures, including those of the old masters, are very inaccurate in their skies. If the painter, whose business it is to observe Nature, has acquired so imperfect a knowledge of clouds, no wonder the average citizen needs instruction concerning them.

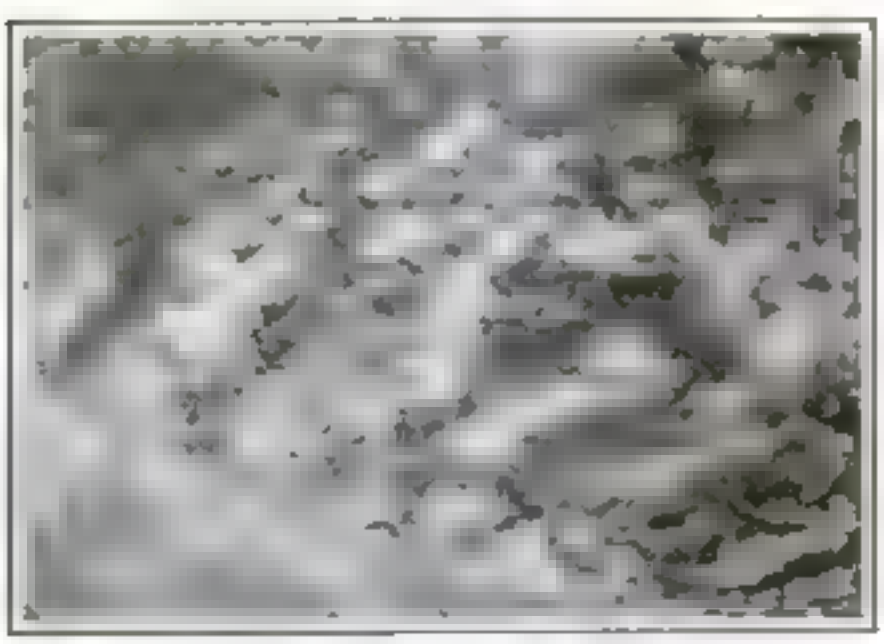
At first sight, clouds seem infinitely various, yet with a little study one can assign them all to a few broad classes. The scientific classification of clouds dates from the year 1803, when an English chemist, Luke Howard, published a description of seven cloud-types, to each of which he gave a Latin name. With a few additions and modifications, Howard's classification is now generally used by meteorologists. This system is based upon three fundamental forms: viz, fibrous or feathery clouds (cirrus), clouds with rounded tops (cumulus), and clouds arranged in horizontal sheets or layers (stratus). Intermediate forms are described by compounding the names of the primary types; e. g., cirro-cumulus, cirro-stratus, etc.

There is really no good reason why the intelligent schoolboy, who knows an oak from an elm and a crow from a turkey buzzard, should not be able to call the clouds by their names. The International Cloud Classification, now adopted for scientific purposes all over



Mammato-cumulus clouds

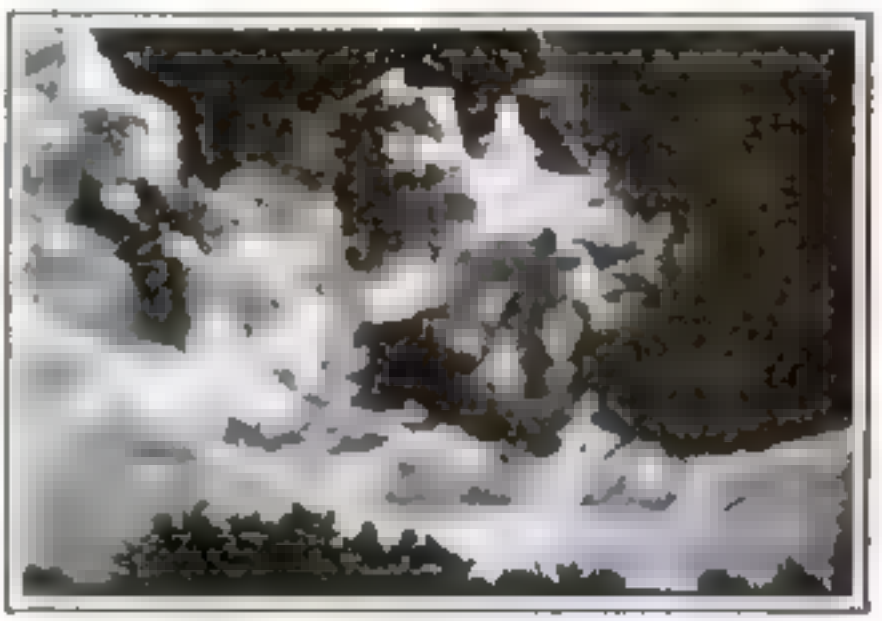
Cumuli with cirri-form appendages



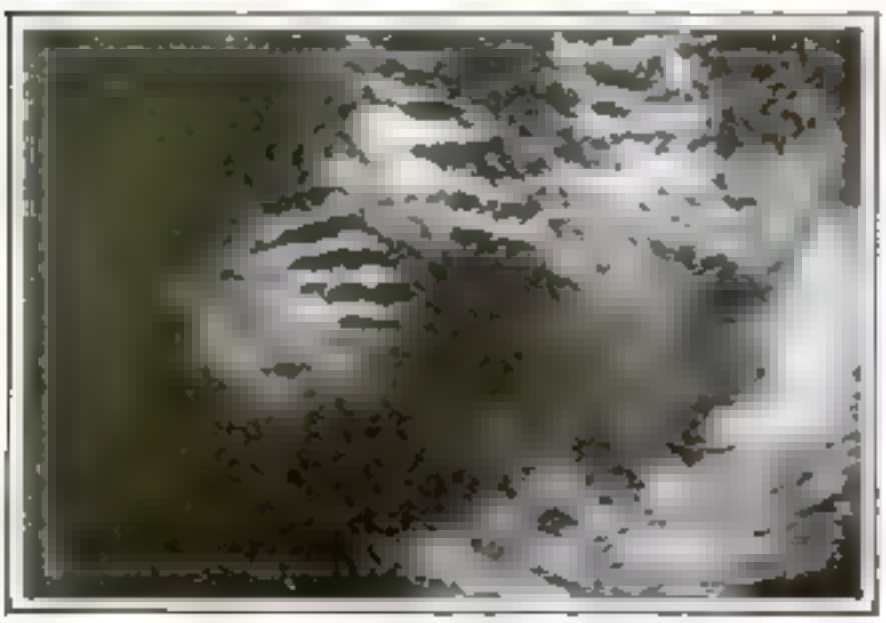
Cumulus mammatus clouds

Alto-stratus clouds

Lenticular clouds



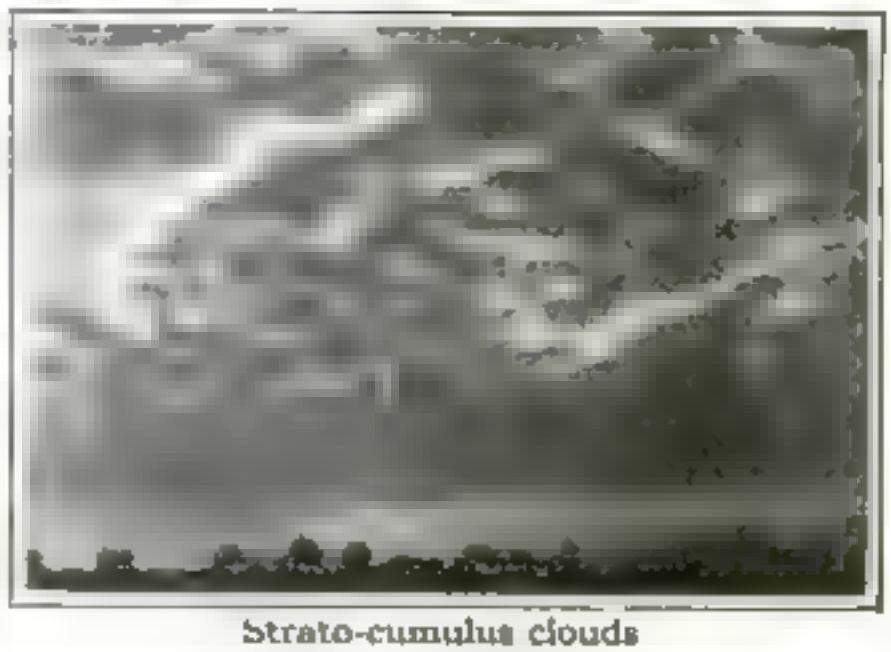
Cumulus, passing into strato-cumulus



A nondescript form of alto-cumulus

Nimbus (rain-cloud),

Anvil-shaped cumulo nimbus



Strato-cumulus clouds

the world, is brief and simple, and must serve as the point of departure in our excursion to Cloudland:

I. Upper Clouds

1. *Cirrus* ("Mares' Tails"). Detached clouds, delicate and fibrous, taking the form of feathers.
2. *Cirro-stratus.* A thin, whitish, often web-like sheet of cloud.

II. Intermediate Clouds

3. *Cirro-cumulus* ("Mackerel sky"). Small globular masses or white flakes.
4. *Alto-cumulus.* Rather large globular masses, white or grayish, partly shaded.
5. *Alto-stratus.* A thick sheet of gray or bluish cloud.

III. Lower Clouds

6. *Strato-cumulus.* Large globular masses or rolls of dark cloud, often covering the whole sky; especially common in winter.
7. *Nimbus.* Dark, shapeless clouds attended by rain or snow.

IV. Clouds Formed by Day in Ascending Air Currents

8. *Cumulus.* Thick clouds with more or less rounded summits and flat bases.
9. *Cumulo-nimbus* ("Thundercloud") The common cloud of summer thunderstorms; a mountainous mass, often turret-shaped or anvil-shaped, generally with a fibrous sheet spreading out above.

V. High Fog

10. *Stratum.* A uniform layer of cloud resembling fog, but not resting on the ground.

The international Classification also recognizes a few minor types: especially *fracto-nimbus,* or "scud," (shreds of nimbus seen drifting under the rain-cloud); *fracto-cumulus* (small detached fragments of cumulus, undergoing rapid change in form), and *fracto-stratus* (formed when a uniform layer of stratus is broken into irregular patches by wind or by mountains). *Mammato-cumulus* ("sack cloud," or "pocky cloud") is a rare and striking cloud form, seen especially in thundery weather, consisting of rounded sack-like clouds, convex downwards.

The photographs accompanying this article will help the reader to interpret the foregoing descriptions. There are several collections of such pictures, known as "cloud atlases," of which the most important is the International Cloud Atlas, published in Paris, with descriptions in French, English and German. Equally useful, however, to the American student is the booklet entitled "Classification of Clouds," with beautiful illustrations in color, issued by the Weather Bureau and sold at twenty-five cents a copy by the Superintendent of Documents, in Washington.

The layman who has learned the cloud names given above will sometimes, perhaps, be puzzled to find a variety of other names applied to cloud forms by technical writers. The explanation is that many specialists have sought to introduce more elaborate cloud classifications; in which, however, the International nomenclature usually forms the substructure. None of these systems has ever come into general use.

Clouds are Composed of Tiny Needles of Ice

Turning, now, from the obvious to

the recondite, let us consider briefly the anatomy of a cloud. The highest clouds, cirrus, cirrostratus, and probably also true cirro-cumulus, with an average altitude of six or seven miles above the earth, consist of tiny needles of ice. All other clouds are composed of drops of water, and do not differ at all in structure from an ordinary fog, which is simply a cloud resting on the earth.

These cloud particles are formed by the condensation of the invisible water-vapor (water in a gaseous state) which is at all times present in the air. Just as water-vapor condenses and becomes visible on the cold surface of an ice-pitcher, so, it is supposed, condensation occurs in the free air on the surface of extremely minute (mostly ultra-microscopic) grains of so-called "dust," when cooled to the critical temperature with respect to the amount of water-vapor present (the "dew-point"). The exact nature of this "dust" is not fully understood

You will perhaps wonder how clouds composed of water can exist in cold weather, when our ponds and streams are all frozen to ice; especially as it is a matter of common knowledge that the temperature of the air diminishes with altitude, so that wintry weather on earth implies wintrier weather in Cloudland. To find the clue to this enigma we consult the books on physics, and learn that, with proper precautions, it is possible to cool a liquid far below its ordinary freezing point (32 degrees Fahr. in the case of water). Clouds of "supercooled" water-drops are seen even in the polar regions. A sudden jar turns a supercooled liquid instantly to a solid; and thus it happens that, in cold weather, raindrops or fog particles turn to ice on coming in contact with terrestrial objects, such as trees, telegraph wires, and the like, giving us the interesting spectacle of the "ice storm."

Clouds are Always Falling

Another paradox is the fact that the bits of ice and drops of water composing the clouds should appear to "float" in the air, though of much greater density than the latter. As a matter of fact they do not. Cloud particles are all the time falling relatively to the air around them; though since this air itself may constitute an ascending current, they are not always falling in an absolute sense. The speed at which a cloud particle falls through the air depends upon its size; the smaller the particle, the more slowly it falls. The smallest have diameters of the order of .0004 inch and fall in still air at the rate of about a tenth of an inch per second. The largest range up to more than a fifth of an inch in diameter, and fall at the rate of about twenty-six feet per second. Raindrops and snowflakes are cloud particles which, in virtue of their size and other favorable conditions, succeed in falling all the way to the earth. Many a shower of rain or snow never reaches the earth, but evaporates in midair.

Reverting to the aspects of clouds as we see them from the earth, there are a few interesting phenomena that require notice. Cirrus and cirro-stratus clouds sometimes occur in long, narrow strips, extending across the sky, and, while really parallel, seem to converge toward two opposite points on the horizon on account of perspective. These strips are called "polar bands," or, popularly, "Noah's Ark." Parallel bands of cloud, whether in continuous strips or in separate cloudlets, reveal the presence of waves in the atmosphere. Where a wave carries a body of water vapor upward the latter cools by expansion and condenses to visible moisture. Thus the clouds mark the crests of the waves.

The "White Flag of the Chinook"

A kindred phenomenon is that of the "cloud cap" often seen over a mountain. Here the ascent of the air, with its charge of water vapor, is due to the upward deflection of the wind by the slope of the mountain. Sometimes the cloud cap, once formed, spreads far away to leeward of the mountain peak, constituting a "cloud banner." Such is the "white flag of the chinook," seen stretching from the crest of a mountain ridge in our Western states when the chinook wind is blowing over it. The same phenomenon constitutes the "foehn wall" attending the foehn wind in the Alps. One of the most famous and striking of

cloud caps is the "table cloth" that spreads itself over Table Mountain, near Cape Town, when a moist wind blows in from the sea.

Sometimes the local topography causes the wind that has swept up over the crest of the mountain to form a second "standing" atmospheric wave to leeward of the mountain, and this may also be marked by a cloud, which, like the cloud cap itself, presents a delusive appearance of permanence, while it is really in constant process of formation on the windward side and dissipation on the leeward. The pair of clouds thus formed—one over the mountain and the other at some distance from it—is exemplified in the well-known "helm and bar" of Crossfell, in the English Lake District.

Alto-cumulus clouds

Cumulus and alto-cumulus (above)

Of all clouds the most majestic are the mountainous masses of cumulo-nimbus that attend our summer thunderstorms. The formation of these clouds can often be watched from its early stages. On a hot, still day the warm air near the earth's surface streams upward by virtue of the same "convective" process that accounts for the draft of a chimney. The diminished pressure prevailing at higher levels permits the air to expand, and expansion causes it to cool. When the ascending column reaches a sufficiently low temperature, its water vapor condenses into cloud. The first visible stage is the appearance of a small cumulus, rounded above and flattened on the under surface, constituting the capital of an invisible column of rising air This occurs at an average altitude of from four thousand to five thousand feet above the earth. In the course of the afternoon one sees these clouds grow and coalesce, until they have towered up to enormous heights; often ten thousand feet or more. Very often the summits become fringed with feathery ice clouds, called "false cirrus," but really identical in structure with true cirrus or cirro-stratus. Sooner or later the violent atmospheric circulation that produces these clouds culminates in disruptive electrical discharges, rain, and hail.

Similar clouds are not infrequently formed over great fires, and almost always over a volcano in powerful eruption. In the latter case an actual thunderstorm is commonly generated.

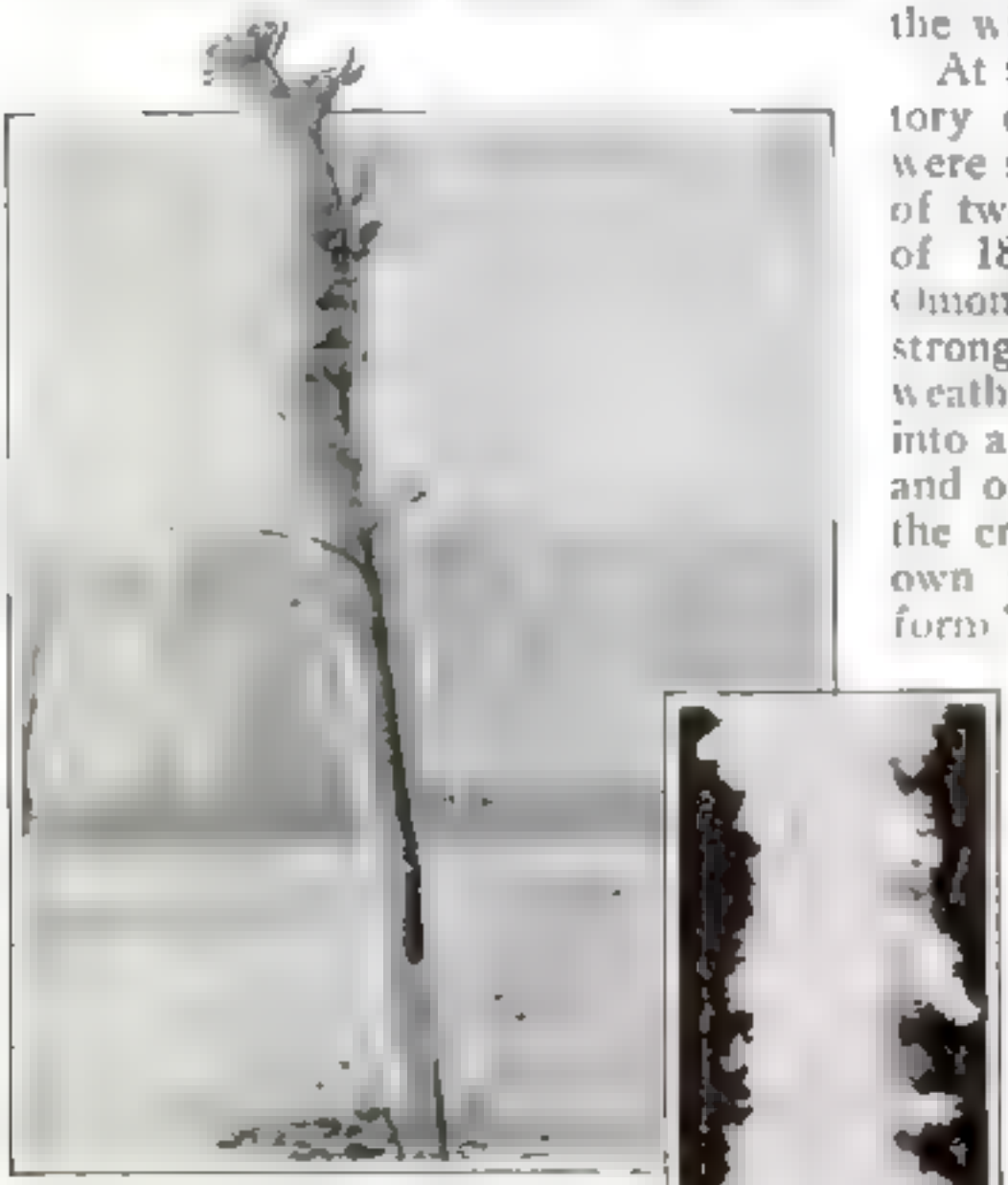
Apart from their shapes, clouds present interesting phenomena of color and give rise to a great variety of luminous appearances, including rainbow, halos, coronas, and the like. These yield much information concerning the structure of the clouds in which any occur. Thus halos occur only in ice clouds, rainbows only in water clouds. The corona (notwithstanding statements found in many books on meteorology) probably never occurs in ice clouds, though it is sometimes due to fine dust in the air. The colors of the rainbow, often described as invariable, really differ considerably from one bow to another, according to the average size of the water drops in which they are generated.

Beautiful iridescent colors may sometimes be detected in clouds, especially along their borders, and not pertaining to a true halo, corona, or rainbow.

What Is Hoarfrost?

IN every-day English the word "rime" is synonymous with "hoarfrost" and is applied to the fine white deposit which replaces dew in cold weather. Hoarfrost is sometimes defined as "frozen dew," but it is more often a direct deposit of small ice crystals from the atmosphere, the invisible water vapor turning to ice without passing through the liquid form.

In recent technical literature the term "rime" has a different meaning. It is limited in its application to those striking deposits of rough ice or of feathery crystals which sometimes form on exposed objects surrounded by fog, when the temperature is below freezing. This formation is, in its turn, distinguished from the smooth coating of ice which results from rain in cold weather, and to which the name "glazed frost" is now applied. Heavy deposits of glazed frost often load branches, wires, etc., to the breaking point, and give us the familiar phenomenon of an "ice storm."



Hoarfrost is a powerful but mischievous magician. Above, a beautiful effect created on a tree; on the right, a wire rope

Of all these various frost deposits, true rime perhaps presents the most curious forms, and these reach their fullest development on mountain summits and in the polar regions. Beautiful tufts and fringes of ice form on objects of small diameter, such as twigs and wires, and along the angles of square posts and the like, but not on broad surfaces. The deposit is almost or quite confined to the windward side, and grows against the wind.

At the former meteorological observatory on Ben Nevis these ice feathers were sometimes seen to grow at the rate of two inches an hour. In the winter of 1884-5, according to Mr. R. T. Omond, "during a long continuance of strong southwesterly winds and cold weather a post four inches square grew into a slab of snow some five feet broad and one foot thick in less than a week; the crystalline mass then fell off by its own weight and a new set began to form."

The anemometers and other out-of-door instruments at the observatory were generally so coated with rime in winter as to be useless.

A Curious Tobacco Pipe-Borer

TRAVELERS among the Sioux Indians are very much impressed with the perfect smoothness of the bore in their pipe-stems. Without the use of a tool of any kind, they make a perfect bore in the twigs of ash trees, which they use for musical instruments and for pipes. To accomplish this end, they employ the larva of a butterfly which inhabits the ash tree. The Indians remove the pith for about three inches from the stick they wish bored. Into this cavity, they place one of the larvæ of a brown butterfly, which gradually eats its way down through the pith until the bore is completed. A little heat applied to the wood expedites the work of the larvæ. The Indians consider both the tube made in this way and the larva as sacred as their idols.

New York Trains That Play Leap Frog

A VERY interesting traffic situation occurs on the long and attenuated Manhattan Island, which makes only one express track necessary. In the morning, New Yorkers travel southward to the down town business sections, and in the evening return northward to their homes

In order to relieve the swelling traffic on the elevated lines in New York city, an ingenious method of track-laying has been resorted to. A horizontal view of the completed structure would bear a strange resemblance to the roller coaster railroads so much in evidence in nearly all of America's amusement parks. Nearing a station, the express trains for which the new track is being designed, rise swiftly on an incline, so that they play at a modified, mechanical game of leapfrog Under the raised tracks, or "humps," as they are known technically, the local stations are situated.

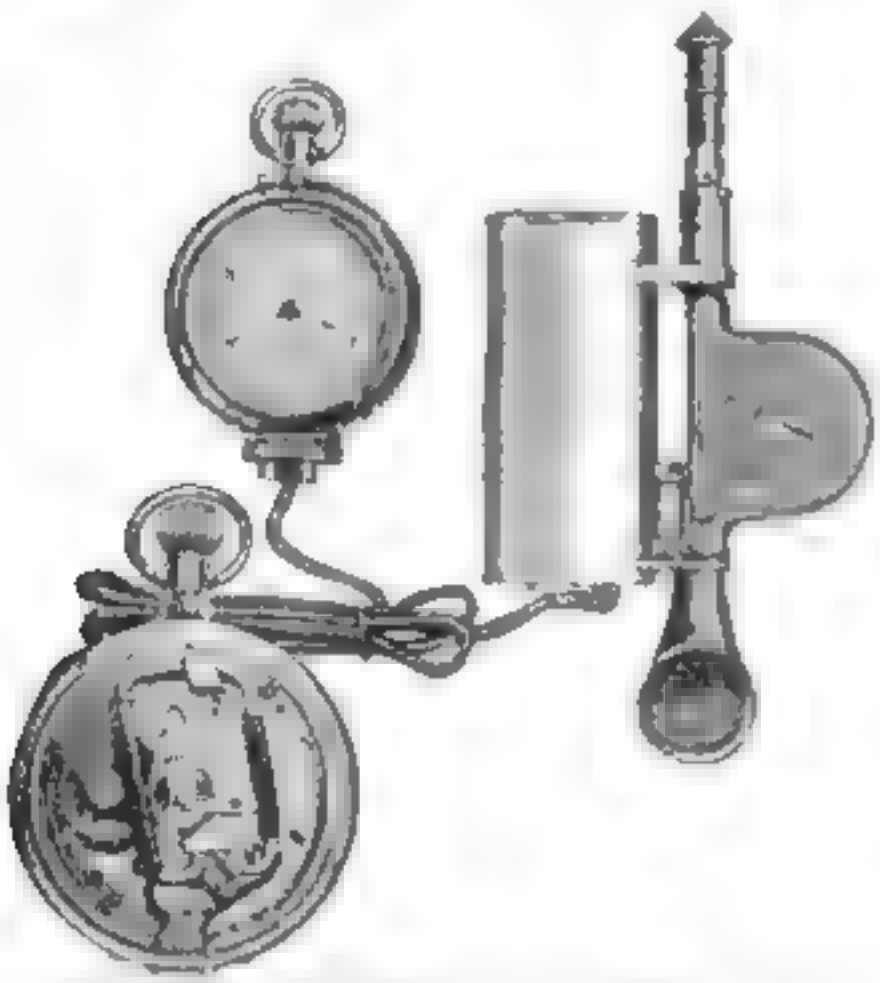
The reason for the leapfrogging is obvious. There are three tracks in service already on the elevated line, but the third track could not be used for express service unless the trains crossed over and on the local tracks to take on and discharge passengers. This would involve delay and a serious possibility of accident, due to the failure of engineers to obey signals.

Passengers riding on the express trains on the new "L" tracks will be reminded of the "roller coasters" at Coney Island

At each express station, the new tracks rise above the level used by the local trains

The stations selected for the express stops are either reinforced or renewed, and the middle track is raised about

twelve feet. The loading platforms for the "extra elevated" express tracks are built over the existing local tracks, which are left unchanged. The length of the "hump" is determined by the grade of the present local tracks at that particular section, as the grade of the express



This device permits accurate timing of the revolutions of a machine

tracks never exceeds three per cent. The new platforms are to be three hundred and fifty feet long.

It is expected that the cost of operation of the express trains will be somewhat decreased as the headway which they get on the incline will carry them some distance before power need be applied. Trains will also be able to stop quickly and smoothly because of the upward incline as they enter the station.

Great credit is due the engineers engaged in the construction of the new tracks, for, with a few brief exceptions, traffic on the local tracks has not been interrupted.

A Revolution Timer and Stop Watch Ingeniously Combined

IT takes skill to time the number of revolutions a machine is making per minute, especially if it is running rapidly. One's attention is so divided between the watch and the revolution counter that it is difficult to start or stop the reading exactly on the second. In order to eliminate the human element and make the reading positive, a Chicago man has connected the revolution counter electrically with the watch.

Within the case of a stop watch is a tiny electro-magnet, which, when energized, allows the second's hand on the watch to run; but the instant the electric current is broken and the magnet is no longer energized, the watch stops.

The electric current is furnished by a flash-light dry battery attached to the revolution counter, and the counter itself is so constructed that the electrical circuit is completed the instant the counter starts to revolve and is broken the instant it stops.

The electrical mechanism does not interfere with the use of the watch, as a time piece or as a hand-operated stop-watch. The revolution counter may be used in the ordinary way if desired.

The Danger of Safety-Tin Boiler Plugs.

THE attention of the Bureau of Standards of the Department of Commerce has been called to a very serious condition in the safety-tin boiler plugs used to warn engineers of dangerous boiler conditions. The plugs, which are made of fusible tin and which are supposed to melt easily when the temperature rises too high, were found on inspection to have become oxidized. Since the melting point of oxidized tin is about three thousand degrees Fahrenheit, one can readily see that the oxidized plugs, far from being a safety device, actually increased the possibilities of danger from explosion. Lead and zinc impurities are found to be the principal causes of this oxidation in the tin; and their elimination by strict inspection is urgently advised by the federal authorities.

Our Women Police

POLICEWOMEN are now employed in twenty-six cities. Chicago has twenty-one; Baltimore, Los Angeles and Seattle, five each; Pittsburgh, four; San Francisco, Portland, Oregon, and St. Paul, three each; and Dayton, Topeka and Minneapolis, two each. Fifteen other cities have one each. Their pay ranges from $625 a year in Dayton to $1,200 in San Francisco.

Charles M. Schwab Lifts a House over Trees: Sentiment vs. Cost

THERE is real sentiment in trees to Charles M. Schwab, especially those trees which have sheltered his fine old homestead called "Immergrun" near Loretto, Pa.

Recently Mr. Schwab decided to build a new palatial summer residence on the site of the old home, but he did not want to destroy the beautiful frame house which has been more home to him than even his mansion on Riverside Drive, New York. The house is entirely surrounded by trees. To move it and not destroy the trees was no unsurmountable obstacle to the man who is furnishing guns and fighting ships for the Allies of Europe.

When Schwab first spoke to his engineers about moving the Loretto homestead, they mapped out for him a plan which sacrificed only three trees. But that was too much for Schwab.

So the engineers attacked the problem again. The photographs herewith show them in the act of moving the fine old Schwab residence over the trees. By the route that is being taken, the house goes over 23 trees before it will reach the road where it will have clear sailing. The maximum height the house will be jacked over is thirty four feet. It then starts on its journey across a deep valley on the Schwab farm where it will find a new resting place. It will travel a thousand feet from its present location and will crown a little hill.

The steel king intends to build a million dollar summer home in the heart of the cluster of trees that this jacking operation has saved.

In order to move his old homestead without destroying it and without killing the beautiful trees which surround it, Charles M. Schwab, President of the Bethlehem Steel Co., told the engineers to spare no expense. Accordingly they proceeded to jack the frame house up to a height of thirty-four feet. It will be necessary to lift the residence over twenty-three trees before it can be lowered

A Queer Adventure in War

MANY aeroplanes are captured during the fighting in Europe; seldom does an aeroplane land on an enemy's aviation field without a fight. At an important British aviation station in northern France a great German biplane [illegible] recently to emerge from the fog. As the anti-aircraft guns were about to fire upon it, the machine circled several times around the field and finally alighted.

Surprise changed to amazement when the English aviators, mechanics and officers saw the German warplane drive quietly across the field and enter an empty hangar. The German aviators calmly said they had lost their way in the fog, and that on becoming short of fuel they decided to alight. Jokingly, one of the Germans remarked, "If you will kindly give us a little petrol we should be able to return home."

Nature has built the largest stadium in the world for the sport-loving population of Cleveland, Ohio. Over one hundred thousand persons watched this baseball game, and thirty thousand more could have been accommodated

A Natural Stadium Which Holds One Hundred and Thirty Thousand

THE largest stadium in this country is not a product of engineering skill but the work of nature. More than one hundred thousand persons, the largest crowd that ever witnessed a baseball game, was assembled in this great bowl recently without taxing its capacity. It is estimated that it could accommodate one hundred and thirty thousand persons.

The natural stadium is part of a city park in Cleveland, Ohio, and all athletic events which take place there are free to the public. It is almost a perfect amphitheatre. The large field, suitable for all kinds of athletic games, is almost completely surrounded by hills inclined at just the right degree to accommodate spectators. At one end there is a break in the hills that affords a convenient entrance and parking space for automobiles.

Fifty Thousand Aviators

TO the average American, the aeroplane is still a wonder, a miracle, a creation of magic. In Europe men have become so accustomed to it, that children now talk of becoming "aviators" as they would of becoming "policemen." Counting both pilots and observers, there are more than fifty thousand men now in Europe, in daily flights above ground. The number increases from day to day, and before the war is ended it is possible that the number will reach one hundred thousand. A hundred thousand human beings taken to the air every day—and only six years ago Glenn H. Curtiss made his first long flight down the Hudson River—a wonderful feat chronicled in the press of the world!

Paper from Grass

TERMINATING a series of experiments, the Department of Agriculture has recently announced that it is possible to manufacture a first-grade machine finished printing paper from zacaton grass, which grows in great profusion from California and Texas southward to the Argentine Andes.

This grass is harvested for the sake of its roots. These are made into brushes of various sorts, and are frequently known as broom root grass. At the present time the tops of the grass are allowed to go to waste. There is reason to believe that from these a satisfactory paper-making material may be developed.

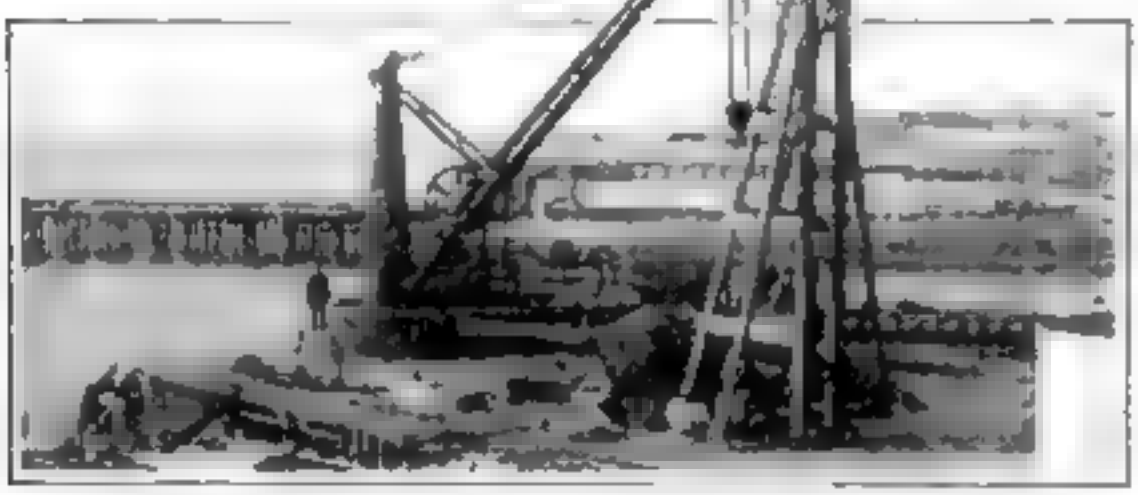
Government Manufacture of Aeroplanes—A National Menace!

By Eustace L. Adams

A GOVERNMENT factory for the manufacture of aeroplanes and motors. The specter which haunts those who hope to see the United States take her place among the nations with a fleet of aircraft which will demand, and receive, respect! The experiment which cost Great Britain nearly five millions of dollars, and produced, altogether, fourteen flying officers and seventeen aeroplanes at the end of a wasted three years!

There is a strong Southern movement, of which Senator Duncan U. Fletcher is a leading spirit, to establish at the new aeronautic base at Pensacola, Florida, a government factory for the manufacture of aeroplanes and motors for the Navy.

It is on these grounds that Florida hopes to see factories established to manufacture aeroplanes



A general view of the wharves at the new Aero Base at Pensacola, Florida

Senator Fletcher, in defending his attitude, says:

"I am strongly of the opinion that the aeronautic base (at Pensacola) should be equipped to manufacture aeroplanes and motors. Not to manufacture all that we may require, but a considerable number. This will act as a stimulus to private manufacturers, as a nucleus for a considerably increased output in war times, as a check on any tendency toward slackness on one hand, or too high prices on the other, by private manufacturers. Experiments may be conducted there which will evolve a highly valuable type of military aeroplane. There a highly trained force may be created, and a training and industrial plant built up, capable of infinite expansion on the government's 1,400 acres, which would be of service that cannot be estimated to the country in time of war. The government has an opportunity to build up a modern manufacturing plant, school and experiment station at Pensacola that will attract the best of the official and enlisted personnel of the Navy as well as the most skilled workmen."

A year ago the Secretary of the Navy requested the Bureau of Construction and Repair and the Bureau of Steam Engineering to investigate and make a report upon the advisability of having the Navy enter upon the manufacture of aeroplanes. This report, which the Secretary transmitted to Congress, advised strongly against such an attempt. Some of the reasons given were:

"It would be a tremendous loss to the

advancement of aeronautical work to lose the ideas and results of private investigation and experiment. The establishing of a government plant for the general manufacture of aircraft would require a complement of officers that could be ill-spared at the present time, not only because the Navy has a very limited number of specially trained designers in this class of work, but because such a plant would call for the diversion from actual flying work of many of the most competent operators. Any government plant which could be established in the near future would be entirely inadequate in war time, as aircraft would be required in large quantities for such an emergency."

The navy has a half dozen of these flying boats which can really fly. It should have five hundred as a basis for a real aero corps

In spite of this report, the project is still being agitated, and numerous officials appear to be in favor of establishing such a factory. Southern newspapers, particularly those conducted in Florida, are jubilant, but it is to be hoped that they are "counting their chickens before they are hatched."

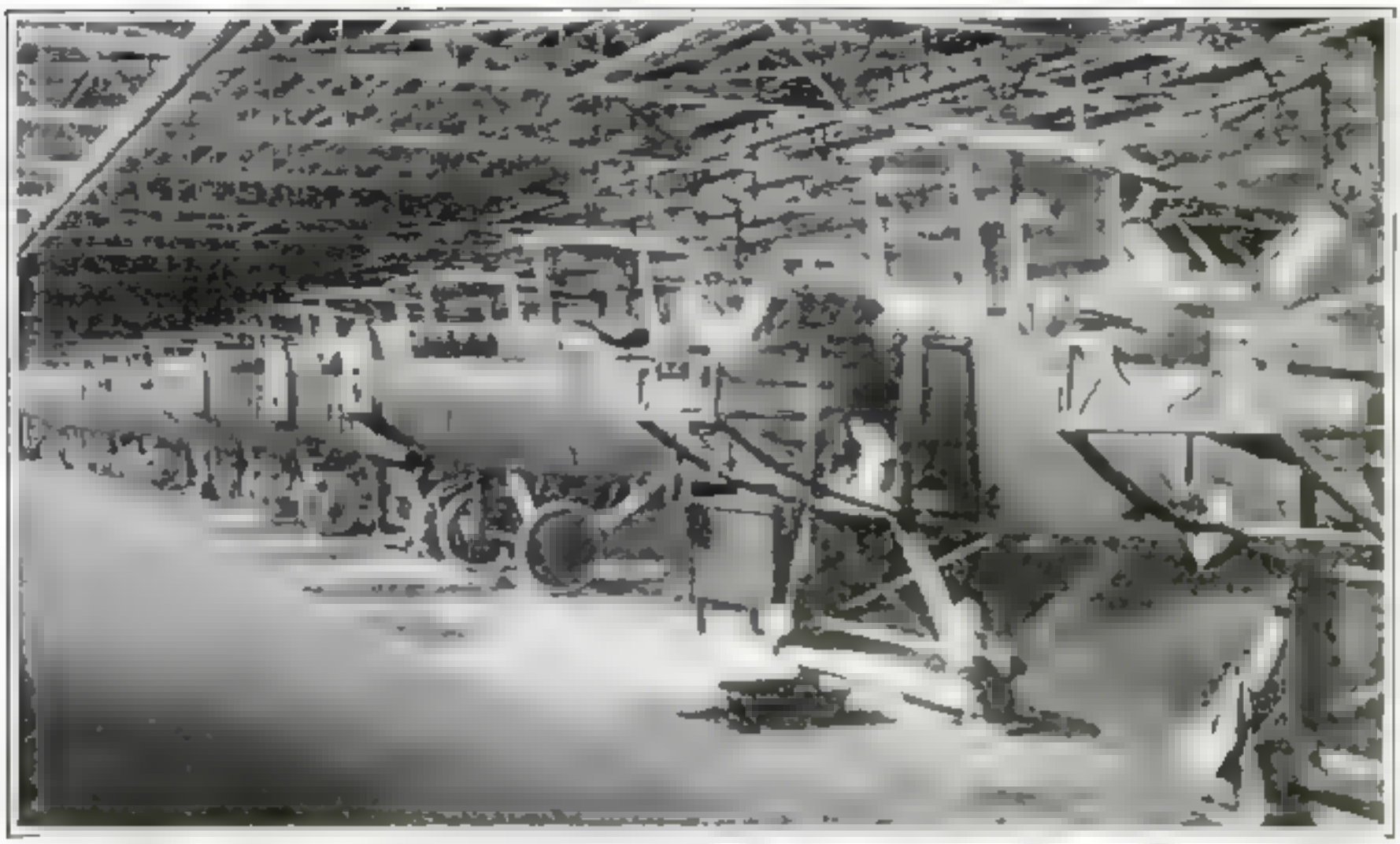
Senator Fletcher says that government manufacture would act as a stimulus to private manufacturers. When did government competition ever act as a stimulus to private manufacturers? Certainly not in Great Britain when the government was conducting its costly experiments along those lines. Great Britain found that by means of government manufacture it could not keep up with the foreign powers in times of peace. How did it hope to produce the thousands of aeroplanes necessary in time of war, especially if the private manufacturers had been driven out of business by government competition? At present, after a year and a half of warfare, and although private manufacture of aeroplanes took a tremendous boom after the failure of the government's experiment, Great Britain is forced to buy almost the entire output of the many American aeroplane factories.

Should war be declared upon this country after the private manufacturers had ceased their efforts, because of government competition, the government factory would not be able to supply the needs of our Army and Navy. It is conceivable that we might not be able to cross the ocean in search of privately manufactured aeroplanes. In that case we would have to build up the industry from the start, while thousands of enemy aeroplanes hummed over our heads, and dropped bombs upon our ships and troops.

Mr. Henry Woodhouse, a Governor of the Aero Club of America, in expressing his opinion of this project to the writer, said:

"Manufacturing of aeroplanes and motors, which Senator Fletcher proposes, is inadvisable, first, because it would retard the development of naval aeronautics, and second, because it would discourage the youthful aeronautic industry. Needless to add, there is, therefore, no argument in favor of the proposition."

There are many persons, interested in the problems of national defense, who see in such a project a real start toward a greater air fleet, and overlook the fact that it is a start in the wrong direction. It is probable that they cannot see the far-reaching evil results of such a step. On the other hand, a large number of far-seeing advocates for real preparedness are displaying great concern that so obvious a "pork barrel" proposition should receive even the most casual attention of Senators and Congressmen at a time when the nation seems at least



An efficient private aeroplane factory. All these Curtiss machines are going to Europe The aeroplanes in sight in this picture are almost double the number that either our Army or Navy Aero Corps has in commission, if only the serviceable machines in both services are counted

awakening to the shocking condition of army and naval affairs, particularly in the branch of aeronautics.

Mr. Alan Hawley, President of the Aero Club, the public-spirited organization that is leading the vast movement to supply the national guard and naval militia of the various states with aeroplanes, said to the writer:

"So long as the appropriations for aeronautics for the Army and Navy are not sufficient to meet the actual need for aeroplanes and for the training of aviators, there is no justification for spending the small amount available for factories and experiments. The dozen or so aeroplane manufacturers and aero motor makers have shown that they are able to supply, in any quantity needed, the type of aeroplanes and motors required, and they have assured us that they will be at all times ready to do their utmost in every way to supply the aeronautical needs of the Army and Navy."

Mr. Augustus Post, one of the fathers of the Aero Club, an experienced balloonist and a pioneer aviator, gives us his views on the matter. He says in part:

"It would seem just at this time that it would be well to purchase what has already been perfected by the manufacturers in this country and so well proven abroad, and that the Army and Navy might well devote their energies, at present at least, to training men to fly and in perfecting an aerial organization which could be moved where needed. The developments are bound to be so rapid in the near future that immediate steps must be taken to keep up with even the present rate of progress, and it would seem that rather than extensive laboratories, schools of flying should be established and the manufacture and inventive side of aeronautics left in the hands of those who are doing so well and who have accomplished so much."

As was pointed out in the last issue of the POPULAR SCIENCE MONTHLY, the aviation corps of our Army and Navy are at the present time, rather ghastly jokes. Congress has continually overlooked aeronautical needs, and the little money appropriated has been sadly misspent. A recent court martial of one of the officers of our Army Aero Corps afforded the public a glimpse into the rottenness of affairs when politics are applied to our infant aeronautical efforts. If government manufacture is

introduced at Pensacola, perhaps it will be the death blow to the hopes of those of us who wish to see the United States, the birthplace of self-sustained flight, provide for its Army and Navy a fleet of aircraft which in time of war would safeguard our Navy, our fortifications, and eventually our homes.

The ice-skating rink which took the place of the popular dance floor in one of New York's prominent hotels

Our Big Birdseed Bill

WHEN one watches a canary daintily picking at its little box of birdseed, one is not likely to reflect upon the large quantity of that food which is eaten every year. Nevertheless, during the past year the canaries of this country consumed a total of four million seven hundred and four thousand six hundred and twenty-five pounds, or two thousand three hundred and fifty tons of birdseed. At the advanced price of five and one-half cents a pound which has been in force since the war made it difficult to import this material, the tiny birds have cost their owners two hundred and fifty-eight thousand seven hundred and fifty-four dollars and eighty-eight cents.

THE average annual fire loss in the United States is about two dollars per inhabitant.

Making a Dancing Floor Into a Skating Rink

NEW YORK, the city of many fads and fashions, is now forsaking the dance floor for the ice skating rink. Dancing, which has held sway for three winters, was doomed to a slow death, even before a substitute was found

It needed only the advent of a successful play in which an ice skating scene was the chief attraction to turn the tide in favor of the rink. Quick to see the coming change, the manager of one of the largest hotels in the city converted his famous dance floor into a skating rink, and at present has the largest in the city, with the exception of the permanent arenas which have catered to ice skaters for a number of years past.

The rink is circular in shape, and consists of a shallow tank which holds five inches of ice. The water was frozen at the beginning of the season by the refrigerating plant of the hotel, and is to remain in that condition until the skating season is over. Every night, when the last skater has left the rink, the ice is scraped, and a slight film of water is sprinkled over the surface. When this water is frozen, it makes an entirely new surface for the next day's sport. It is said that the rink was made at a cost of about twenty thousand dollars.

Hazards of Aeroplane Making

AEROPLANE manufacturing must now be rated among the hazardous employments. At a foreign aeroplane factory a number of workmen employed in the varnishing department were taken seriously ill, and two deaths resulted.

Upon careful investigation the cause was found to be poisoning by tetrachlorethane, an ingredient of the varnish used. These accidents led to an order forbidding the use of varnish containing a high percentage of this deadly chemical.

Roger Babson and his staff work in the open air. As the thermometer often drops below the zero mark, the office force must be heavily clothed. The heavy woolen mittens make it impossible to operate the machines with speed, so two curved sticks are provided with which the keys are depressed. Good speed is thus attained

A Business Office in the Open Air

ONE of the most remarkable testimonials ever given for the fresh air cure is that of Roger Babson, the famous statistician, at his Wellesley Hills, Mass., office. The confinement of Mr. Babson's work broke his health to such an extent that his physician ordered him to live in the open, even during his working hours

A large office, built in the rear of his building, was so arranged that it could be enclosed in stormy weather. As may be supposed and as our illustrations show, his office force is heavily clothed the altitude is high, and the thermometer often drops below the zero mark

The main difficulty was found in operating their typewriters. It was necessary that the hands of the typists be protected with heavy woolen mittens; but even with this covering, it was almost impossible to operate the machines with speed. The difficulty was solved when Mr. Babson suggested the use of two curved sticks. These are held one in each hand, to depress the keys, in much the manner that a Xylophone performer plays upon his instrument. After some practice, the stenographers become expert in the use of these novel tools.

Saving Men from Scalding Steam in Steamship Engine Rooms

THE engine and boiler room forces of a steamship need no longer die like rats in a trap when a steam pipe explodes and fills the compartment with scalding vapor, if the invention of Mr. Ernest H. Peabody and Walter B. Tardy, of New York, is adopted by any of the steamship companies.

At present the life of coal-passers and engineers is one of extreme hazard, for in modern steamships the engines are driven by forced feed. This means that the boiler rooms are filled with air at a high pressure, driven into the compartments by means of a blower, and passing into the fire boxes to give the flames greater heat. To keep the compartments under this pressure it is necessary for the men to enter or leave by means of air locks, where one door has to be shut before another is opened. This method of entrance and exit is, therefore, very slow, and should the compartment become suddenly filled with steam or noxious gases, all the men at work could not gain the outer air in time to save their lives.

In order to obviate this difficulty, the inventors provide a tank extending from the engine or boiler room under the bulkhead to the adjacent compartment. In case of accident the men jump into the tank, and the force of their jump carries them under the bulkhead, which extends several inches under the surface of the water, thus shutting off the gas or steam from the adjacent compartment. When the men rise to the surface, they appear in the safe compartment on the other side, which compartment is fitted with an exit leading to the deck.

The tank, which is constantly filled with water, is about eight feet deep, thus allowing those escaping to become completely submerged and to pass safely under the bulkhead. The water acts as an effective barrier to the escape of the steam or gases into the adjacent compartment, and at the same time offers a ready means of hasty escape for men who may be caught in the room when an accident occurs.

A modification of the invention is shown in Fig. 2 of the illustration. Instead of having the tank filled with water, a series of valves are arranged to blow a draught of air from the bottom of the empty tank. This blast will be forced upwards in that side of the tank located in the gas-filled compartment, and will blow back the steam or noxious gases, so that they can not pass under the bulkhead separating the two compartments. A trap is set in the floor a few inches from the tank, so that the first man to reach the tank will step on the trap and open the air valves.

Another modification specified by the inventors is the use of a large room between the two compartments, which is operated in the manner of an ordinary air lock, but is so arranged that when the door is opened, a great quantity of water shall be sprayed from sprinklers in the ceiling, as shown in Fig. 3. This water will drive out or condense the steam or gases so that the men may pass through the room in safety.

Testing Shrapnel Shells in Electric Ovens

AN electric oven for testing shrapnel shells has been introduced by a Chicago firm. This oven is for use in one of the government arsenals for the purpose of ascertaining the amount of heat which the shells can withstand. For twenty-four hours, each shrapnel shell must be exposed to a temperature of one hundred and twenty degrees Fahrenheit; and by the use of an automatic thermostat the temperature is maintained at this point for the desired length of time. A pilot lamp outside the oven indicates whether the current is on or off. On a continuous test of more than twenty-four hours, the temperature in the oven did not vary more than one degree.

When a steam pipe explodes and fills the boiler room with scalding vapor, the firemen may jump into a tank of water, and when they rise to the surface, they are in another compartment, with means of safe egress to the open air

As the photograph shows this huge ant-hill has been deserted by its original occupants to make room for two-legged inhabitants

An Ant-Heap as a Look-out Station

ONE of the most destructive of African insects is the white ant This strange little creature, well under an inch in length, erects huge heaps in which to dwell. In some places, particularly in the Congo, these heaps convert an otherwise flat country into a hilly one. They rise from twenty to fifty feet and more in height. Invariably they are crowned with several bamboo trees, which often attain a height of another thirty to forty feet. Then the heaps are often covered with beautiful ferns and the choicest of wild tropical flowers.

The ants themselves are most destructive, demolishing everything except iron and steel. They go about in vast armies, and in a single night the damage they will do is almost incredible. They will enter huts or tents and attack everything that is not made of iron. Curiously enough, they only destroy that portion of the object that is not exposed to the air. For instance, they eat away the soles of boots, leaving the uppers standing in their place. It is only when you come to pick up the object that you find it has been destroyed. The photograph depicts a deserted ant heap in the Congo which the surveyors converted into a look-out station.

Living In a Tree Stump

IN the big timber section of the Pacific Northwest many huge fir and cedar stumps are to be found, reduced to mere shells through the action of fire or rot. Some of these stumps measure twelve feet in diameter.

The pioneers of this region often utilized these hollow stumps for cattle shelters, storage rooms or even as dwellings for short periods. If open to the sky, a roof of "shakes" was put on, which kept the interior dry. Open fires could be used, as the huge stumps acted as chimneys, creating an excellent draught.

The accompanying photograph shows a big Washington cedar, in which four men lived for over two months some forty years ago. They were engaged in building a home for one of the party, who is pictured standing beside the stump, which he has carefully preserved.

Four men lived for two months in this tree stump while building a permanent home

Detecting Fires in the Holds of Transatlantic Liners

BY means of an apparatus which is now found on many of the large trans-Atlantic steamships, the officer on duty on the bridge can instantly detect any fire which breaks out in any of the holds or compartments.

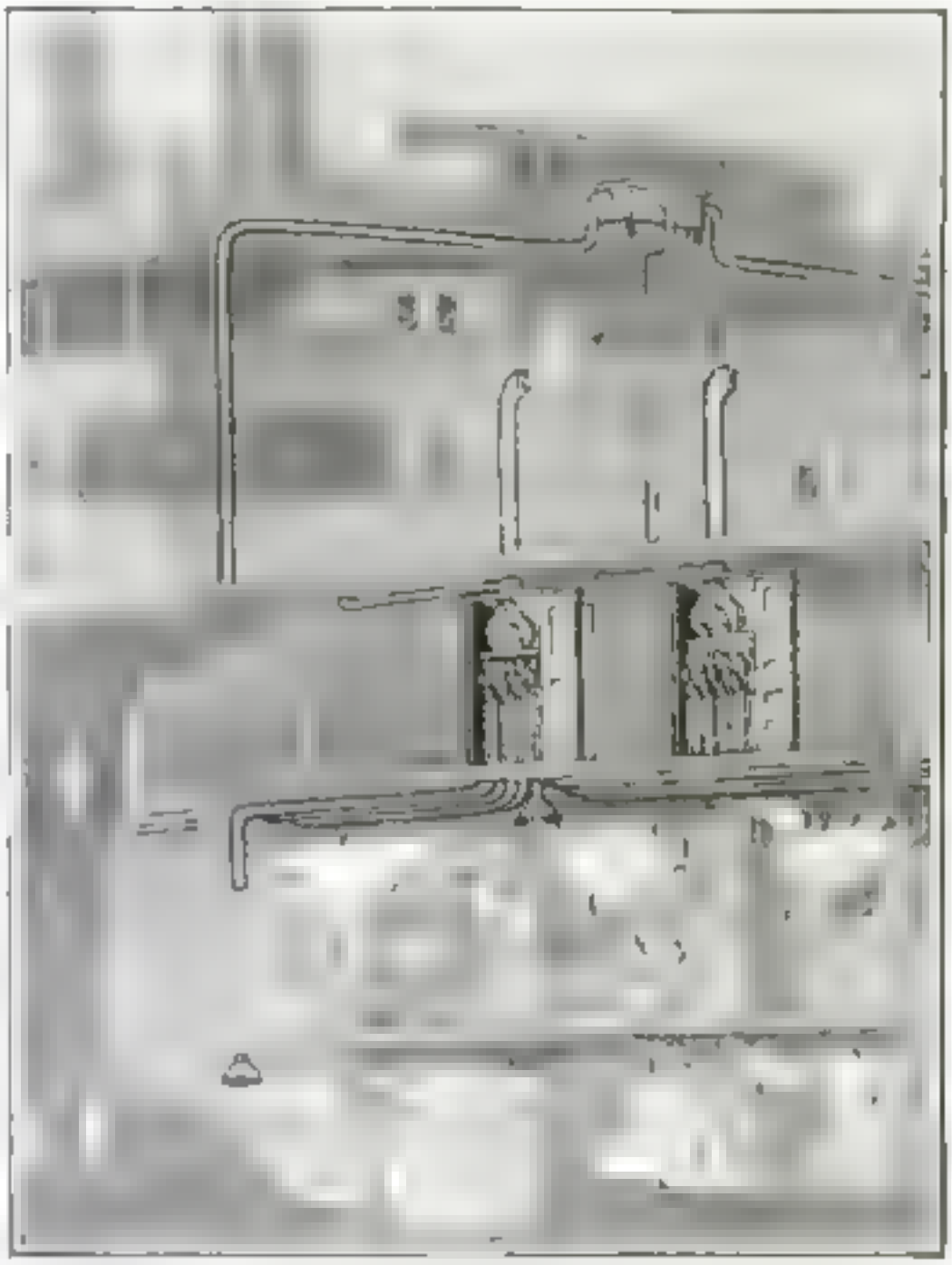
This efficient indicator consists of a set of pipes extending from each of the holds directly to the wheelhouse. At the terminals in the wheelhouse is a set of electric fans which draw air from the holds into a glass case to which the pipes lead. Should a fire start in a hold, some of the smoke would be drawn through the tubes into the glass case, and would be noticed by the officer.

As soon as the fire is discovered, the officer opens the case and fastens to the open end of the tube a steam pipe, which sends live steam through the tube into the compartment and smothers the blaze.

This device has met with considerable objection among ships' officers, because it was claimed that the noise of the electric fans was found very disturbing to the officer on duty, and also that the apparatus took up a large amount of space, particularly on large steamers with numerous compartments to be protected.

In order to overcome these objections, the inventor, William Rich, an American, living in Liverpool, England, has taken out patents for improvements over his original device. A set of small glass cases, one serving for several compartments, is located on the bridge, or wheelhouse, while the remainder of the apparatus is located in a more convenient part of the ship. In the terminal compartment for the tubes is a set of fans which draw the air from the holds, and another fan which serves to send a smaller amount of air from each of these tubes through pipes into the device in the wheelhouse. Each of these smaller tubes leads into a bottle or container which is filled with lime water.

If a fire should break out in a hold, the smoke is drawn into the terminal box for the tubes as before, but is immediately drawn on until it reaches the glass jars containing lime water on the bridge or in the wheelhouse. The carbon dioxide carried up with the smoke turns the fluid to a milky color. The officer can then order live steam turned into the tubes to smother the fire.



The moment a fire breaks out in the hold, it is detected by the officer in the pilot house and by the watchman on deck, by means of the system of tubes and fans indicated, which carry the smoke to the bridge or the deck

With this new device, all the fans and the cumbersome apparatus are located in a distant part of the ship, while only the small set of glass cases is found in the wheelhouse, where saving of space is of more importance.

The chief advatages in the system obviously lie in the fact that a fire can be discovered immediately, and can be extinguished quickly by means of the same apparatus.

How to Sit Straight and Still be Comfortable

THE ordinary straight-back chair encourages incorrect posture. It does not conform to the natural mould of the back. The sitter must assume a slouching attitude to be comfortable.

The cushion fits into the small of the sitter's back and encourages him to sit upright with the chest properly raised

All this is remedied by a simple device invented by Dr. J. H. Kellogg of Battle Creek, Michigan. The device is a small leather or cloth bound cushion which may be attached to any chair. This cushion is so placed that it fits into the small of the sitter's back and enables him to sit upright, with chest properly raised and at the same time to be comfortable.

Concrete to Replace Willow Mats

EXPERIMENTS have been made by the United States Bureau of Standards to develop a method for accelerating the hardening of concrete in order that concrete may be substituted for the willow mats that have been used in the past along the Mississippi River. As a result of the experiment, it was found that four per cent of calcium chloride added to the mixing water increases the strength of the one-day-old concrete one hundred per cent.

Testing a Hack-Saw's Strength

IN order to prove that a hack saw is an instrument of remarkable tensile strength, an experiment was recently conducted at Springfield, Mass. It was found that the thin steel would sustain without injury two hundred and eighty-two pounds, the weight of two men.

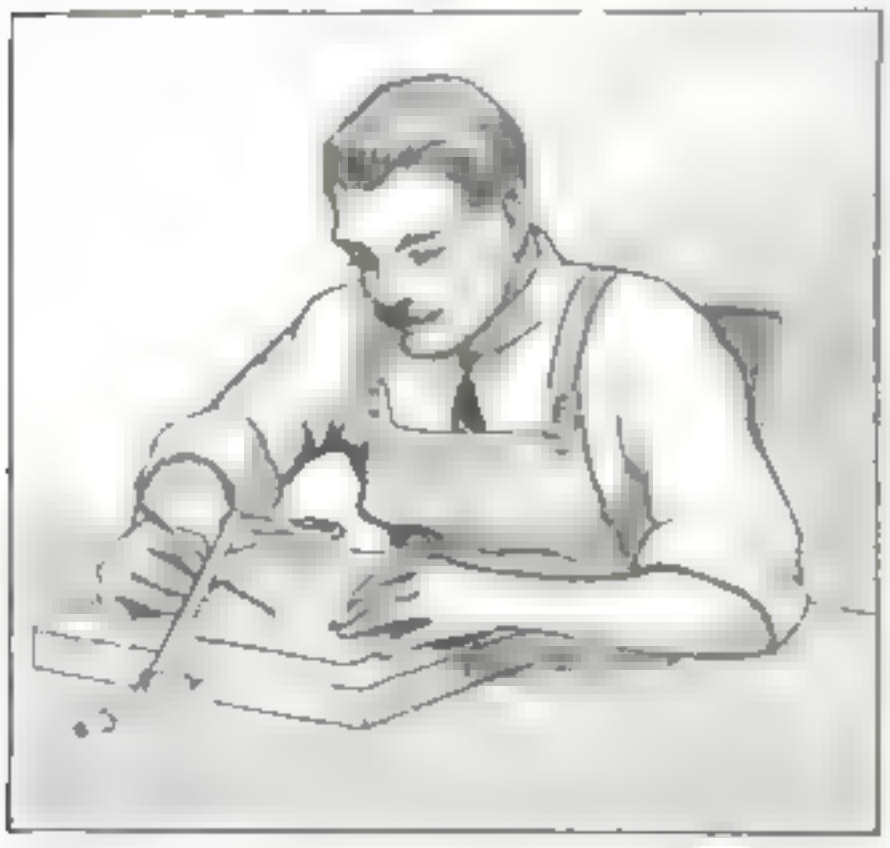
Much damage is done to hack saws by too speedy operation, the operator often forgetting that it is the action, not the speed, that does the work. A hack saw should not be run faster than forty to sixty strokes a minute, and no blade will stand a higher speed without injury.

The thin hack-saw, although bending badly, is supporting two hundred and eighty-two pounds without damage to itself

A Lens That Remains in Focus

WHEN dissecting small objects under a magnifying glass, and in many similar operations, inconvenience is caused by the object's continually getting out of focus as the work progresses. An English inventor has hit upon an ingenious method of overcoming this difficulty by fixing the lens to the tool so that when once focused it will always follow the point of the instrument. The illustration shows a lens fitted to a teazing needle in a wooden holder for dissecting purposes. The arrangement consists of a sliding sheath, A, capable of being slid to-and-fro along the holder, but gripping with sufficient force to maintain its position after adjustment. To this is pivoted an arm, B, to the other end of which a shorter arm, C, is similarly attached The latter carries the lens, which may be anything from two inches to three inches focal length, and from one inch to one and a quarter inch in diameter.

A lens mounted in the manner described above, will be found a great convience for the purposes of microscopical and botanical dissection, fine engraving on metals and the more delicate photographic retouching. Provided the holders are round and of a size suited to the sliding sleeve the attachment may be fitted equally well to a dissecting knife, scalpel, teazing needle, steel scriber, or a photographic retouching pencil.



When the microscope is properly adjusted, it remains in focus without further attention

The wire-drainer clasps over the edge of the kettle and holds a row of doughnuts suspended so that they may drain

Wisconsin Cook's Doughnut-Drainer

A LONG-FELT want of the American home has been a doughnut drainer, a device that would save the housewife from getting her fingers burned with spatterings of hot lard. Mrs. Lyda M. Schultz, of Dorchester, Wis., has devised one of wire that clasps over the edge of the doughnut kettle and holds a row of doughnuts suspended over the kettle where they drain off on being taken from the kettle.

The doughnuts cook in less than half the time it requires without the drainer, according to Mrs. Schultz, thus saving fuel, time, energy and lard, and the doughnuts are better. The drainer is easily cleaned. A shake in hot water and it is ready to hang up to dry. The drainer can be used with equally good results in making shoe string potatoes, potato chips, fried oysters, dumplings, greens, vegetables, and even fried bacon.

SWITZERLAND is best supplied with postoffices. There is one for every nine hundred and sixteen inhabitants.

And Now Comes the Front-Wheel Drive Motor-Cycle

AMONG the many new forms of locomotion which are continually startling the public appears the front-wheel drive motor bicycle. This novel

This front wheel drive motor cycle will run one hundred miles on one gallon of gasoline

machine is equipped with a device very similar to the motor wheel to be seen on the street.

The motor wheel in this case is actually the front wheel of the bicycle, and it is claimed by the makers that it embodies the correct principle of pulling the load instead of pushing it. This method of construction permits of a direct transmission of power, the usual chain, belt or shaft drives being eliminated. The front wheel bears the weight of the motor, while the weight of the rider is borne by the rear wheel

The motor is a single cylinder, four-cycle, and air cooled. It is said that it will drive the machine at a speed of twenty-five miles an hour for a distance of one hundred miles on one gallon of gasoline.

Three-Wheeled 'Rickishas for Asia

A CONSIGNMENT of five hundred jinrickishas has been shipped to Calcutta, India, for distribution throughout the Orient, with the intention of eventually displacing the two-wheeled 'rickishas now in use in Asiatic countries. The two-wheeled 'rickishas have a great disadvantage in the unpleasant way they often tip out the passenger when the coolie drops the handles to the ground. The new 'rickisha eliminates this disagreeable feature, and it possesses an added advantage, because of having pedals, in keeping the feet of the coolie from the ground. Wet pavements and muddy roads have been the cause of many deaths among the jinrickisha coolie population of Asia ever since that vehicle was first introduced by an enterprising American missionary in the lands where the 'rickisha reigns.

Some of the new jinrickishas are provided with storage batteries and an electric motor, but the majority of them are driven by foot pedals. The gearing is comparatively low, to adapt the new 'rickisha for hill climbing

Another consignment of five hundred of the vehicles will be shipped as soon as the American factory, where they are made, can turn them out. They are destined for India, China, Philippine Islands, Java, and the Straits Settlements

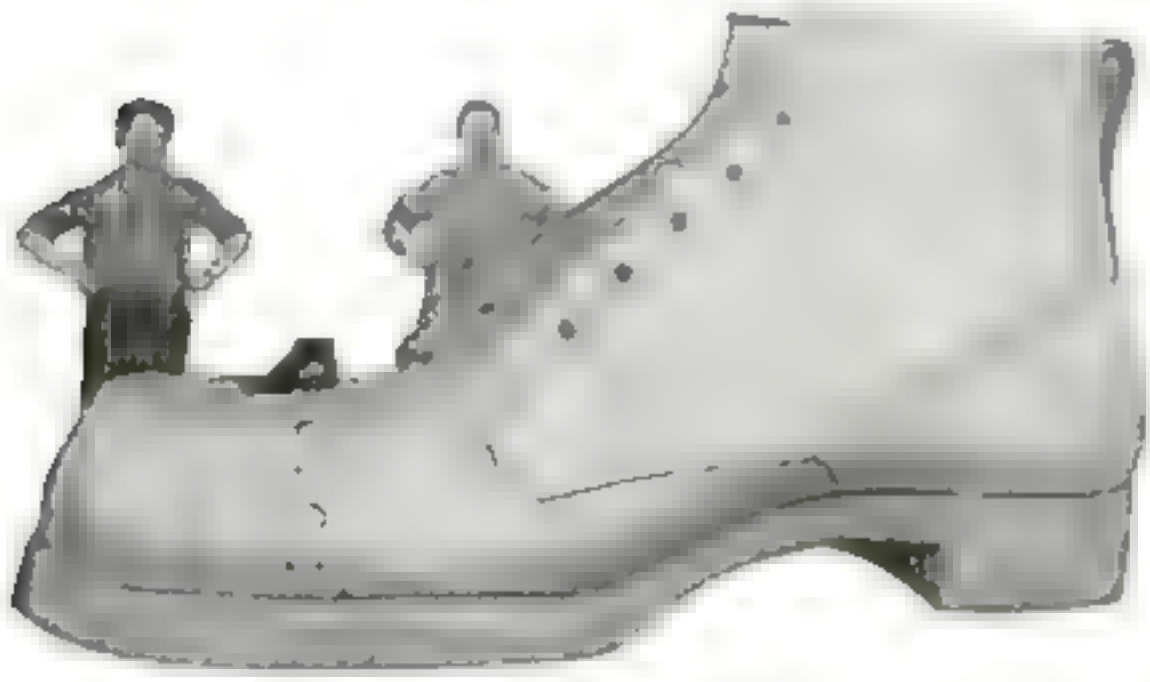
A Makeshift Polarity Indicator

TWO lengths of soldering wire attached to the two wires of a direct current circuit and suspended in a weak solution of sulphuric acid will serve as an emergency polarity indicator. After the wires have been in the solution for several seconds, one of them will become covered with a brown layer, indicating that the wire is connected to the positive side of the circuit. The brown layer is lead peroxide.

Tricycle jinrickishas are now used in the Orient, thanks to American salesmen

A Giant Metal Shoe

A PERFECT shoe more than fifteen times as large as the ordinary man's shoe, and weighing five hundred pounds has just been made by a manufacturer of Peoria, Ill., to be used as a part of an advertising sign.



This giant shoe, fifteen times as large as an ordinary shoe, is complete in every detail, even to the eyelets and heel strap

The shoe is made entirely of sheet metal and is seven feet six inches in height, fourteen feet long and four feet eight inches across the sole. It is complete in every detail, even to the eyelets and the strap for pulling it on, and is a perfect, magnified counterpart of the small shoe after which it was patterned.

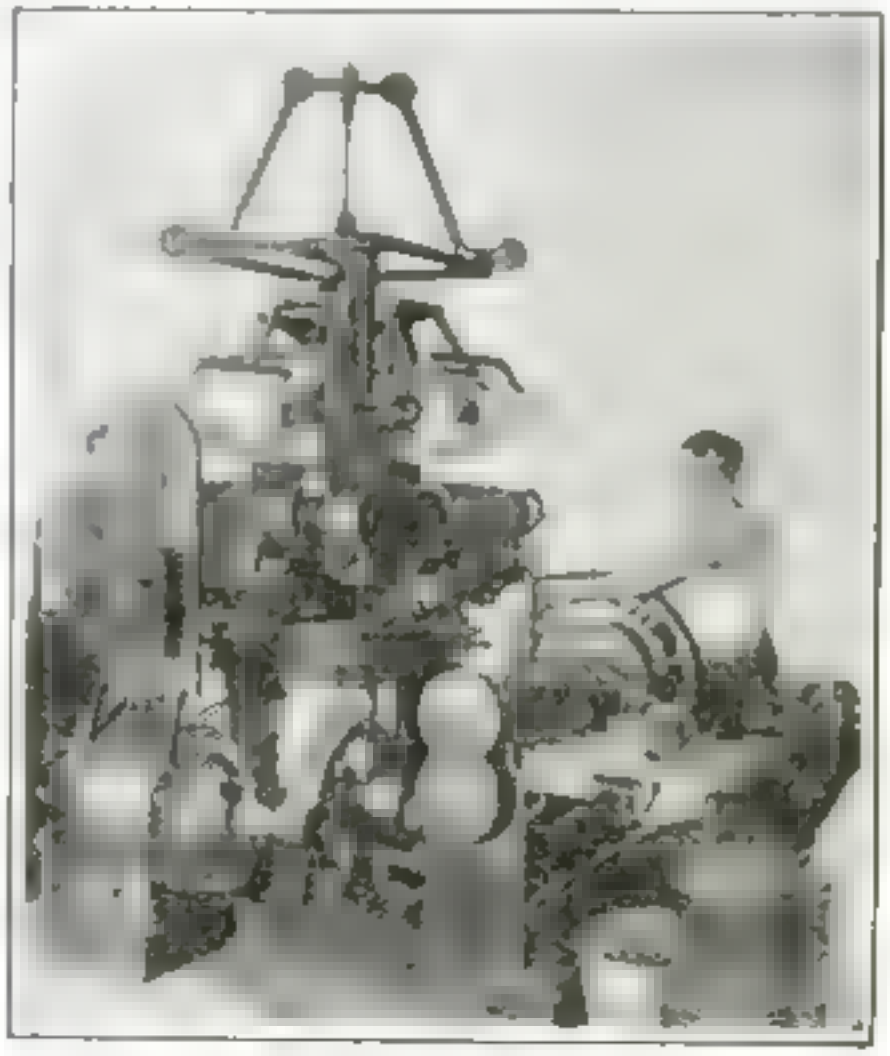
Painting Cars Rapidly

A PROCESS has been patented by which a railway car can be thoroughly painted, inside and out, in a fraction of the time usually required. The car is first given a priming coat and put in a drying oven which has a temperature of 250° F. After drying for three hours, it is removed and painted. Another three-hour period of baking follows, after which the car is ready for a second coat. This process is repeated until the car has not only been painted, but the necessary letters are also placed on the sides and it is varnished within. The length of time required depends upon the number of coats that are given and the quickness with which they are applied.

Making An Automobile Tire Casing

ONE of the most interesting sights in almost any one of the great tire factories are the great machines which are used in tire making. The one illustrated is used for making casings. Two men work together at each machine and their combined output is twenty-five finished casings per day of ten working hours.

Patterns conforming to the shape and size of the tire are mounted on a revolving wheel. The operator builds up a tread on this foundation. From spools of prepared fabric, cut to the proper width, lengths unwind automatically over the tire structure, the casing being built up in successive layers. The number of fabric strips is governed by the sectional diameter of the tire. For example, a four inch tire requires five strips, a four and one-half inch tire, six strips, and the large five inch tire requires seven strips. These processes, of course, prepare the tire only for the ovens where it remains for varying periods according to the rubber stock, size of tire, and construction.



One machine like this will turn out twenty-five finished automobile tires a day

A Saw That Stands Up

ONE of the inconveniences of the ordinary handsaw is that it will not stand readily against a wall or a sawhorse. The least jar causes it to fall. This is neither good for the saw nor pleasant for the owner. A saw invented by a California man has two small teeth on the end of the blade which catch in

The two small teeth prevent the saw from slipping when leaned against a box

the floor just enough to keep it from slipping. With these points against the floor only a very slight support at the side is sufficient to keep the saw upright.

Josef Hoffman Invents a Shock Absorber

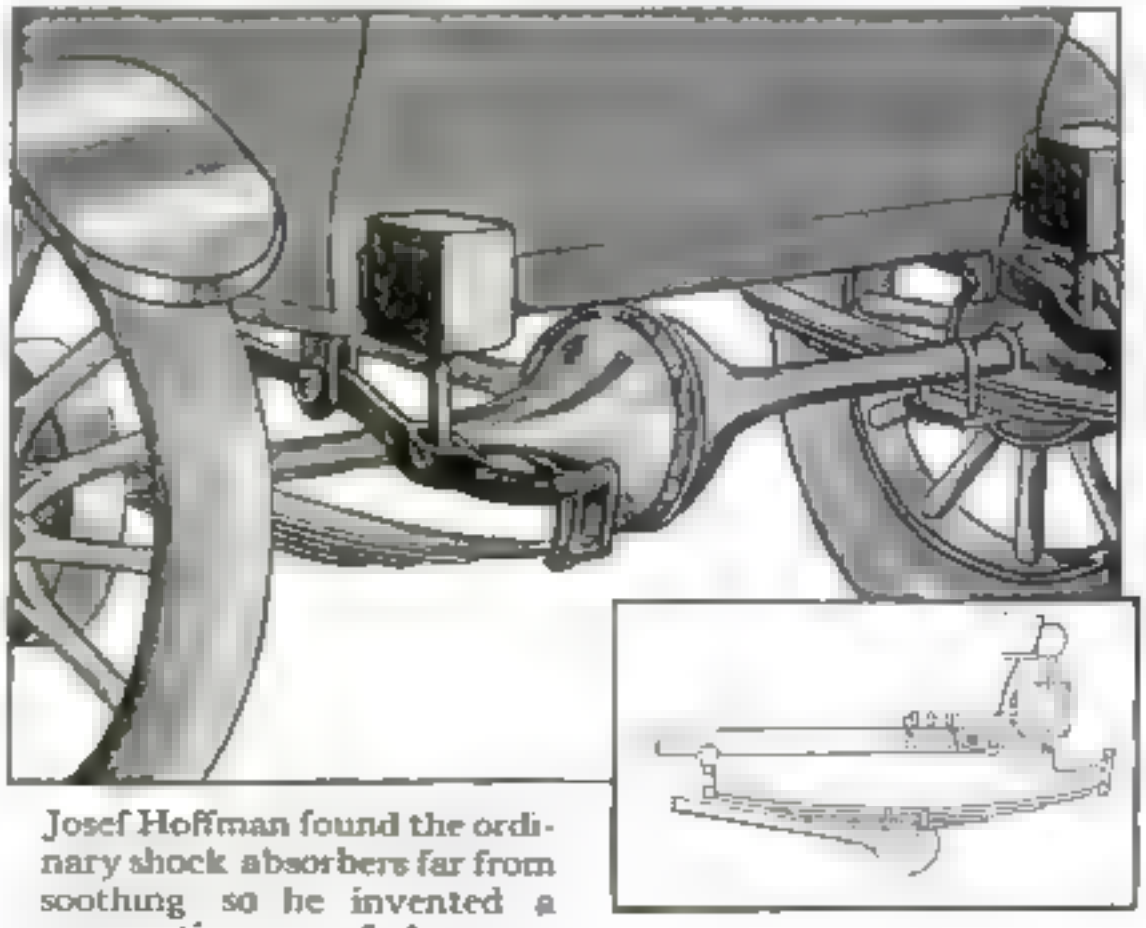
THE avocations of genius are always interesting, and sometimes really valuable. The hobby of Josef Hoffman is science and mechanics, and above all automobiles. He has patented several automobile improvements. The latest of these is a pneumatic spring and shock absorber for automobiles, on which he was recently granted a United States patent.

Mr. Hoffman has found that the ordinary automobile spring or shock absorber tends to bind when there is a side displacement between the body and the spring, as for example, on a curve. His pneumatic spring is an improved type which is designed to eliminate all the sliding contact both from between the parts of the pneumatic spring and from the parts of the steel springs.

The device consists of a cylinder, a plunger, a diaphragm, and a connection between the ends of the steel springs and the plunger of the pneumatic spring. The plunger is guided solely by the air held with the cylinder, which contains the diaphragm. Thus, when once the plunger is set centrally within the cylinder, the air will not permit the plunger head to get out of center; but if, by some unusual force, its center is disturbed, the plunger will immediately spring back to its normal position. A perfectly safe guiding of the plunger is thus provided, and all sliding contact eliminated.

The diaphragm is made of a grooved fabric, so as to enable the compressed air in the cylinder to reduce the diameter of the plunger. This reduction in size permits the diaphragm to enter the cylinder, whose walls it has shortly before been touching. The entire device may be connected to the body and the semielliptic springs of the ordinary car.

This apparatus is inexpensive and so simple in its construction that it cannot readily get out of order.



Josef Hoffman found the ordinary shock absorbers far from soothing so he invented a pneumatic one of his own

When the tradesman shuts the door of this receptacle, it can be opened only from the inside of the house

Door Parcels-Receivers

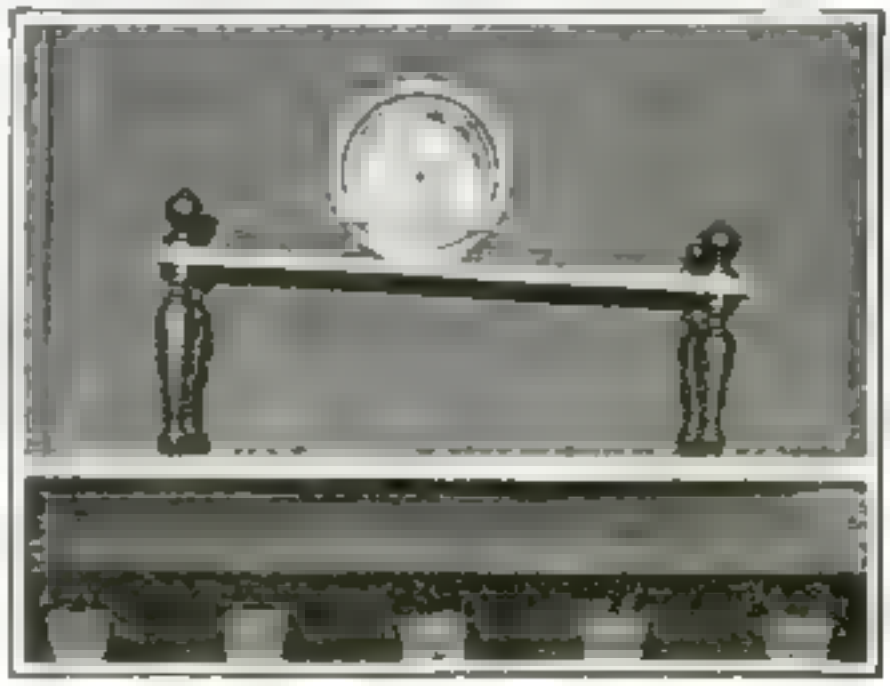
EVERY housekeeper has times when no member of the family is at home when the day's supply of milk or meat or groceries are delivered. Some dealers will not leave parcels when there is no one to receive them. The milk and the meat tempt roving cats and dogs. In city homes, at least, the chance of human thievery has also to be considered. It is now possible to have a special kitchen door fitted with four box-like compartments, one above the other. Each compartment is independent and is for a definite kind of supplies. Each has a door opening outside and another inside the house. The tradesman finds the outer door unlocked and closes it upon his delivery, after which the receptacle can be opened only from within the kitchen. Even if the housekeeper be at home it is convenient to have such an arrangement to save her coming from upstairs or from the basement laundry.

A Handy Darkroom Lamp

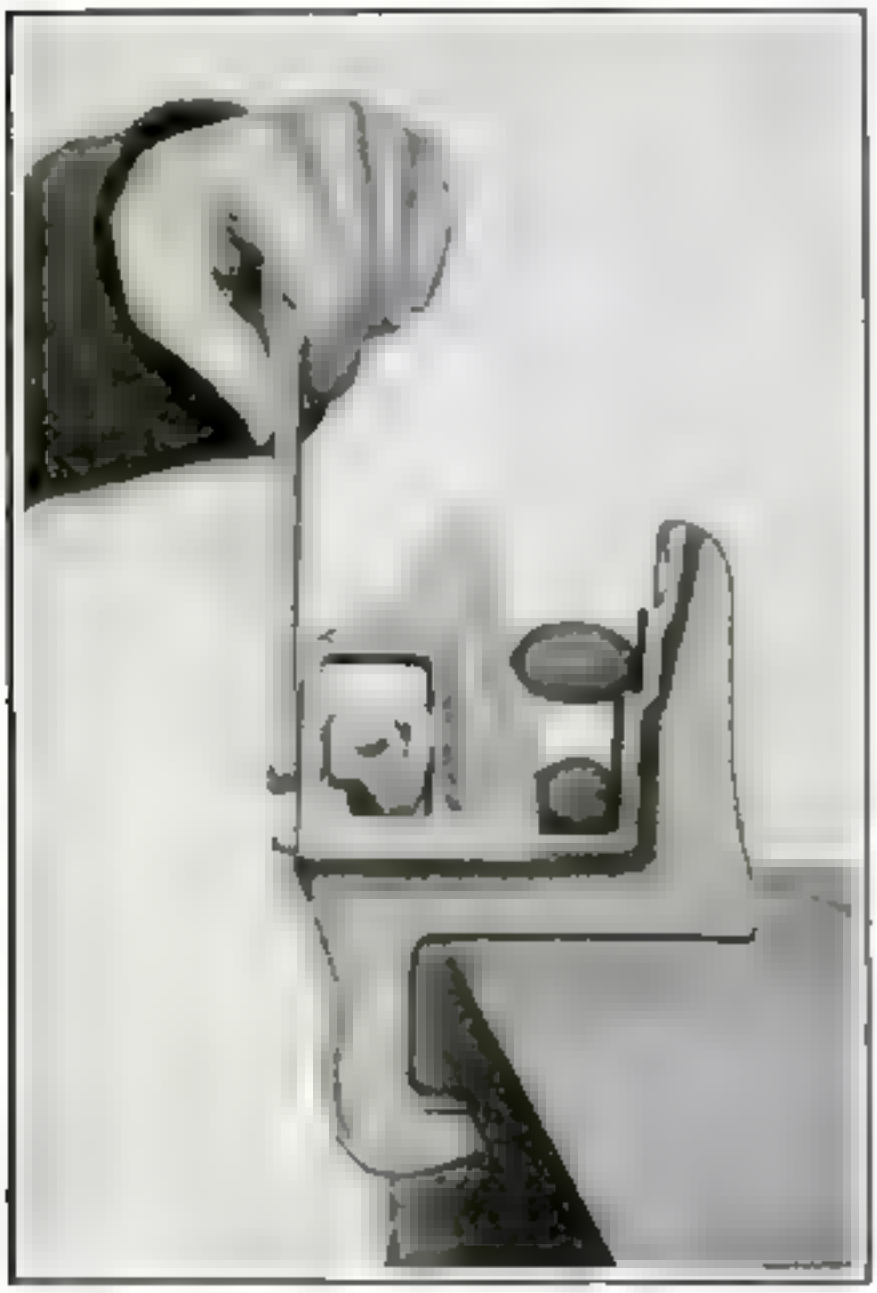
A LAMP that can be used for printing and lighting the developer tray while the print is being developed can be made by covering one side of a wooden or metal box with orange or ruby paper or glass and leaving the other side open. The covered side should cast its light on the developer tray, while the open side can be used for exposing the print.

A Rolling Clock

AN oddity in the way of a clock has lately been invented by a young jeweler in Los Angeles who claims that it is more accurate than the ordinary timepiece. The clock is placed upon the high end of a small table which is eighteen inches long and of polished mahogany. Gravity draws it to the other end of the incline, but the speed is controlled by a wonderful system of weights in the clock. There are no springs and therefore no winding. Every thirty days the clock runs the eighteen inches and is then taken up and started all over again. The case revolves as it runs down, but the dial remains in the usual position.



It takes this clock thirty days to roll the length of the stand



The leverage is so great that three nuts may be easily cracked at the same time

Cracking Nuts Three at a Time

A NEW vise-like utensil to crack nuts easily and quickly is designed for use in the kitchen in preparing a large bowl of nuts for table consumption or cracking nuts for use in cakes or other confections

The new cracker consists of a small vise equipped with a large handle to give adequate leverage. A simple worm moves one of the vise jaws. The jaws are notched so that nuts of different sizes can be broken and so that more than one nut can be cracked at a time. The leverage obtained by this construction is so great that it is very little effort to operate the handle, a point that is of great importance in preparing brazil nuts or hickory nuts for the table.

"Growing Pains" are Rheumatism

ACCORDING to Dr. Mary H. Williams, an English specialist in diseases of childhood, "growing pains" are nothing but rheumatism in the vast majority of cases.

A Bird-House That Can be Cleaned

A BIRD-HOUSE that can be "house-cleaned" each year before the feathered tenants return from their southern pilgrimage has just been perfected by J. C. Hubbard, a Battle Creek, Michigan, lover of birds. The new house obviates the loss that sometimes ensues because particular varieties of birds will not raise a second brood of youngsters in an old nest—they want new quarters for each nesting.

The washable bird-house is made of a frame and a roof into which a hollow cylinder fits, held firmly in place by pegs. After the nesting season is over and the birds have gone south, the house can be cleaned by simply removing the pegs and allowing the cylinder to drop down A garden hose is all that is needed to make the renovation complete. When the vernal migration is over the former occupant finds the old home clean and fresh and as inviting as a new house.

By removing a few pegs, this bird-house may be opened and cleaned for the next coming of the birds

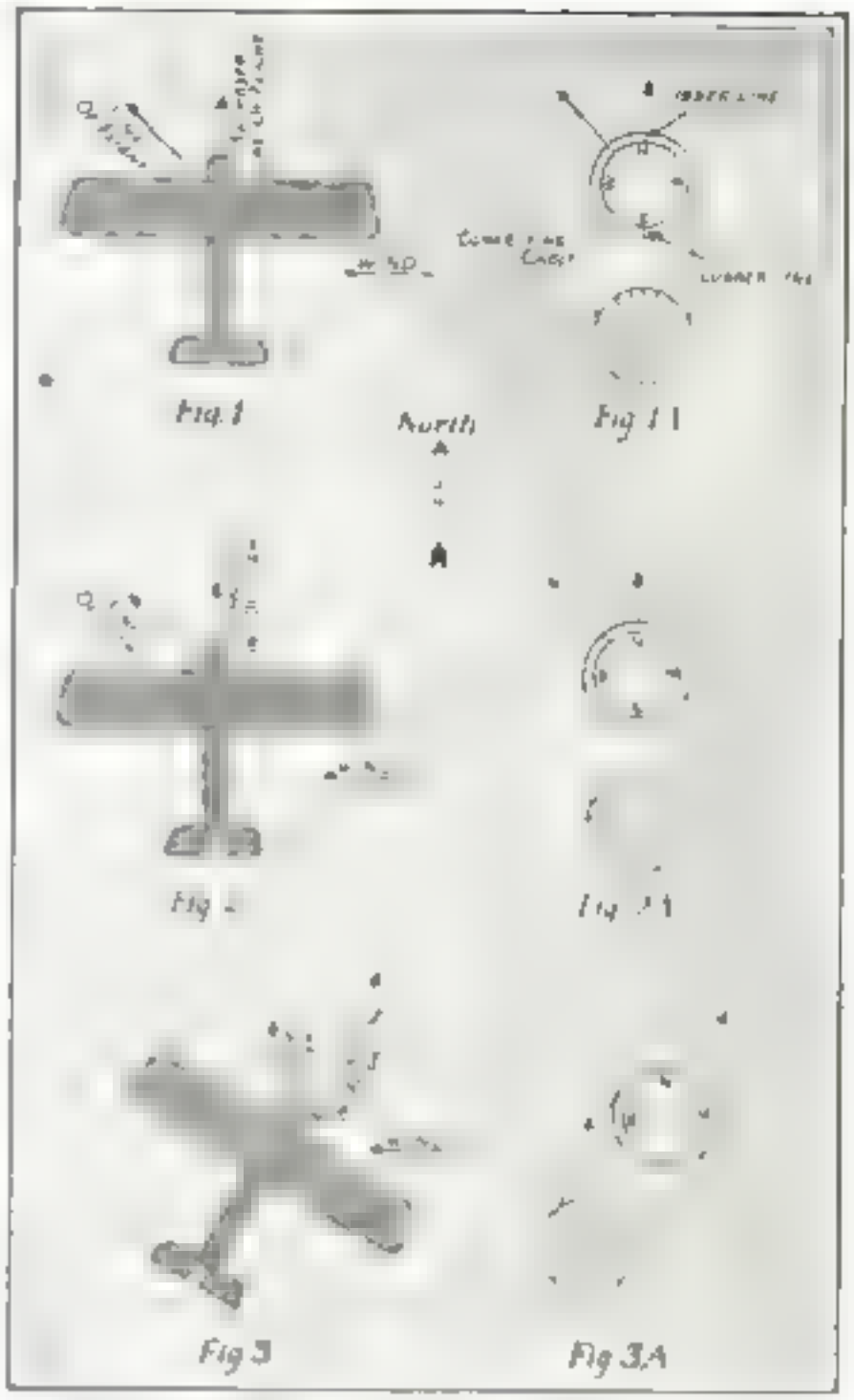
Aeroplane Drift and What It Means

WHEN making a flight between two distant points separated by water, or over strange ground on which there are no familiar landmarks, an aviator uses a compass like any sailor. He may find his bearings at any time during the trip by plotting a line on his chart in the direction in which he has been travelling. Then by estimating his rate of speed and the length of time he has been flying he obtains a point on this line which represents his position at the moment. Such was the plan which Lieutenant Porte originally intended using in navigating the *America* on his proposed transatlantic flight.

Serious errors are possible in steering by compass, because no correction is made for drift with the wind. Of course, there would be no drift in a perfectly calm atmosphere; but the air is unfortunately a very unstable medium, filled with currents of varying velocity and direction, which insidiously divert air craft from their supposed line of flight.

This is illustrated in Fig. 1, where the aeroplane is shown heading due north and the aviator naturally supposes that he is flying in that direction. A strong east wind is blowing and carrying him northwest. He cannot feel this wind because he is moving with it and the longer he flies the farther he drifts from his objective. This matter had never received very serious consideration until the transatlantic flight of the *America* was planned, and then it loomed up as a serious problem. A gyroscopic stabilizer had been installed and automatic control ensured, thereby relieving the aviators of much responsibility, save that of "setting the course." Yet with the *America* well on her way there would have been no certainty as to where she would have landed, although the pilot might have kept her absolutely upon the compass course.

The air compass, like the mariner's compass, is provided with a mark known as the "lubber-line," a line usually engraved on the compass case and representing the bow of the ship. Generally there is a corresponding line 180° distant representing the ship's stern. While



Showing different wind conditions met by aviators during a flight, and on the right the corresponding readings on the drift indicator in each case

the "compass needle," is frequently referred to, nautical compasses are provided with a card to which several "needles" are affixed on the under side. This card, bearing the cardinal points, is held toward the north through the influence of the earth's magnetism. It will be seen, therefore, that when a northerly course is to be sailed the ship must be so maneuvred as to bring the "N" on the card directly opposite the "lubber-line," as shown in Fig. 1A.

Now let us again consider drift. Suppose we set our course as described and the conditions are those disclosed in Fig. 1. If we are flying at a reasonable height we see below us so much of the earth's surface that we appear to be standing perfectly still in space; we know we are progressing because we would fall if we were not. We can rely only upon the compass for our sense of

direction. If we look at the earth through a telescope, however, we limit our field of vision to a comparatively small area, which rushes past so rapidly that we are unable to distinguish a single object. The earth seems to "flow" under us.

If you have carefully followed the foregoing explanations you will be quite able to appreciate fully a drift indicator which has recently been developed and which is regarded as one of the most important contributions to the science of aviation.

The lubber-line is engraved on a movable ring mounted inside the compass and encircling the compass card. A telescope, provided with five fine cross-hairs, is mounted at any convenient location and so connected with the lubber-line ring that any movement of the telescope results in a corresponding movement of the ring.

When the aeroplane is flying as indicated in Fig. 1, the positions of the lubber-line, the compass card and the cross-hairs of the telescope are as shown in Fig. 1A. Looking through the telescope the earth appears to flow in the direction of the wavy lines. We know the aeroplane is drifting, and at once we set the cross-hairs to parallel the lines of drift; the lubber-line is automatically and simultaneously moved in the same direction and to the exact number of degrees. Fig. 2 shows the aeroplane following the course unchanged, but the compass card Fig. 2A indicates our course to be actually northwest and not north. Fig. 3 and 3A show that the pilot has swung his craft around to meet the changed conditions. While the aeroplane is heading northeast, the actual line of flight is now due north.

Dust from the mop falls through the sieve and is caught in the dustpan

Battery Wax Recipes.

THERE is nothing better for the upper edges of glass cells or open-circuit batteries than hot paraffin. Brushed about the upper edge it prevents the sal ammoniac or other fluids from creeping up over the top.

The paraffin can be colored, if necessary, with red lead, green dust, or powders of various kinds. Generally the paraffin is used without color, so that it has a frosted appearance when cool.

A black wax for stopping the tops of dry cells and coating the tops of carbons is composed of tar and pitch in equal parts. These are made into a pasty mass with turpentine heated over a stove, but not over an open flame because the ingredients are inflammable. The compound should be like very thick molasses, so that it can be worked with an old knife.

Another good black wax is composed of paraffin, eight parts; pitch, one part; lamp black, one part. Heat the mixture and stir it until thoroughly mixed. Apply with a brush or dip the parts into the warm liquid.

Oil Mop Cleaner and Dustpan

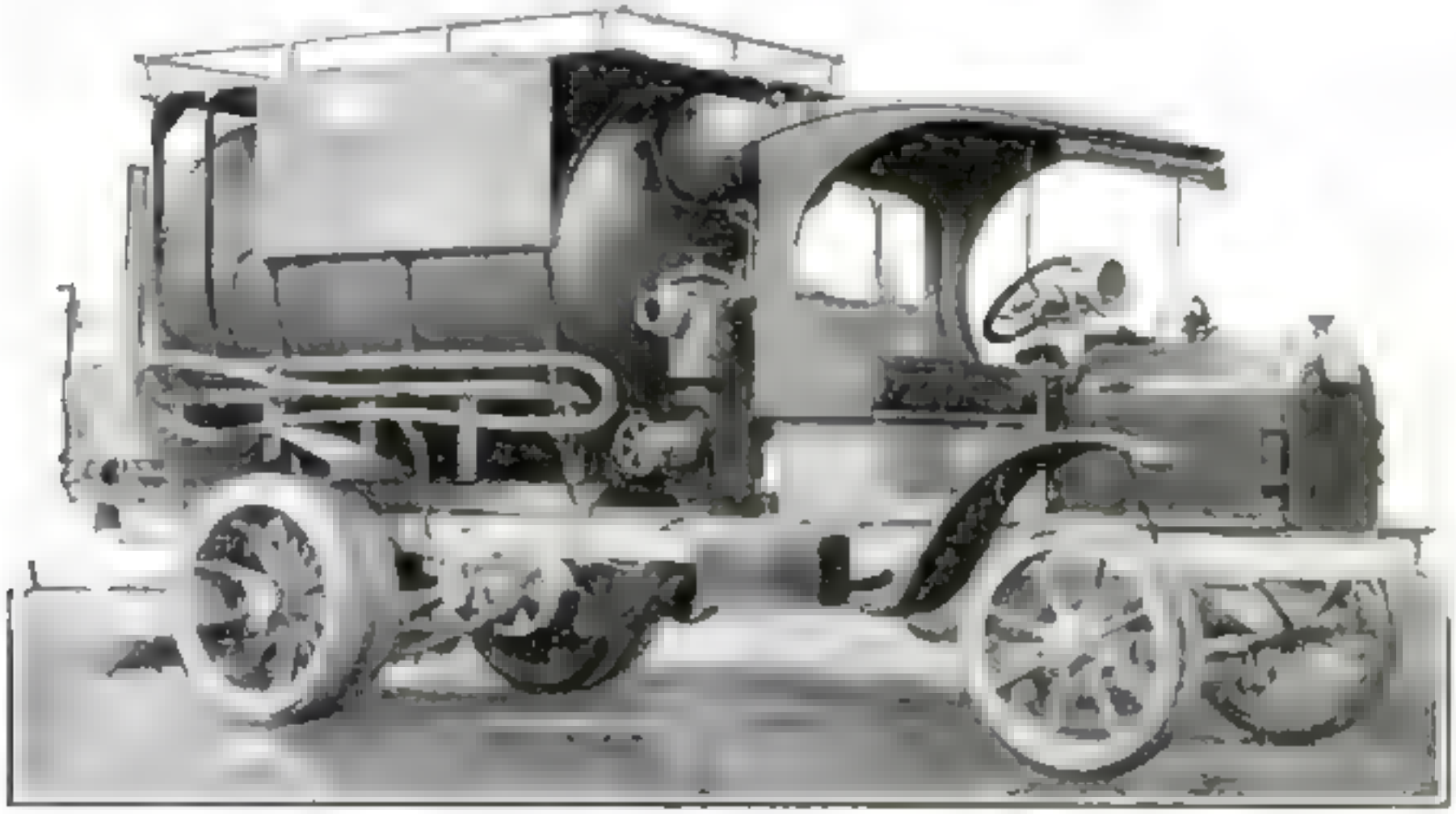
THE oil or polish mop is coming into very general use in homes with finished floors. The dust is quickly picked up in the soft yarn mesh of the mop but the problem of removing the dust from the mop then arises.

A special cleaner has been devised which is also a dustpan. One holds it in place with a foot upon the short handle, and combs the mop back and forth over a perforated platform, the dust falling into the dustpan beneath. This can be used in the house as well as out of doors.

Applying Hot Road Material

TO be impervious to water and to resist wear to the greatest possible degree, roadways must be impregnated with hot tar or some similar material. This condition demands vehicles which combine the necessary distributing apparatus with a plant for heating the road material.

The truck illustrated herewith is of five tons capacity and is one of three recently installed in Baltimore, Md. The truck has a four cylinder gasoline motor, and this also operates a powerful air compressor with which the hot liquid is forced out on the roadway.



To obtain the best results, the tar to be used in making roads must be sprayed while hot. A great tank truck has been built, which has a small boiler on the rear of the chassis to keep the material at the desired temperature

The material within the tank is maintained in a liquid state with the aid of a small flash-steam boiler, which is mounted at the back of the chassis and which may be fired with either kerosene or gasoline. From this generator, superheated steam is led through the material in a continuous flow by means of pipe-coils.

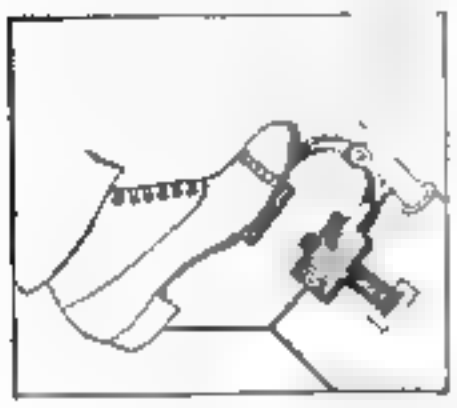
THE most remarkable gold and silver beetles are to be found in Central America. Some have the appearance of burnished gold while the others are like silver. They are worth $35 apiece.

With the Forty-Niners

THE historically important discovery of gold in California was made in January, 1848, at John Sutter's mill on South Fork of American River near Coloma, a point only ten or fifteen miles southeast of the town of Auburn. From 1850 to 1853 the greatest yield was derived from the gravels, and the largest annual output for this period was more than sixty-five million dollars in 1852. There was some reaction in 1854, due to previous wild speculation, but a production of about fifty million dollars a year, chiefly from placer mines, was maintained up to the year 1861.

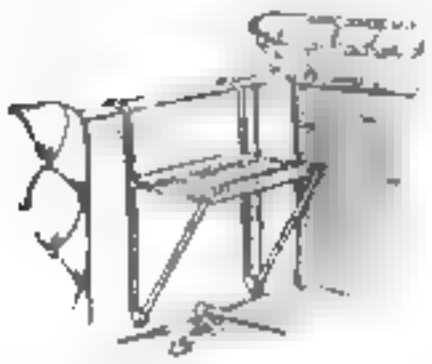
At first the gold was won chiefly from the gravels along the present streams. Those who first got possession of the rich bars on American, Yuba, Feather, and Stanislaus rivers and some of the smaller streams in the heart of the gold region, made at times from one thousand to five thousand dollars a day. In 1848 five hundred to seven hundred and fifty dollars a day was not unusual luck; but, on the other hand, the income of the great majority of miners was far less than that of men who seriously devoted themselves to trade or even to common labor.

An Adjustable Auto Foot-Pedal for Short-Legged Drivers



SHORT persons usually have difficulty in driving an automobile because of the distance of control pedals from the seat. Especially is this the case in cars made in large quantity, where no allowances are made for the varying leg lengths of prospective owners and drivers. For the convenience of these short-legged persons there has been brought out the two-step extension pedal, which can be attached and adjusted in a few minutes. The pedal consists of two sections with a serrated joint, similar to that of the adjustable handlebars on bicycles. The pedal can be adjusted to suit any driver and is nickel plated.

An Extra Seat for Ford Cars Which Hangs on the Door

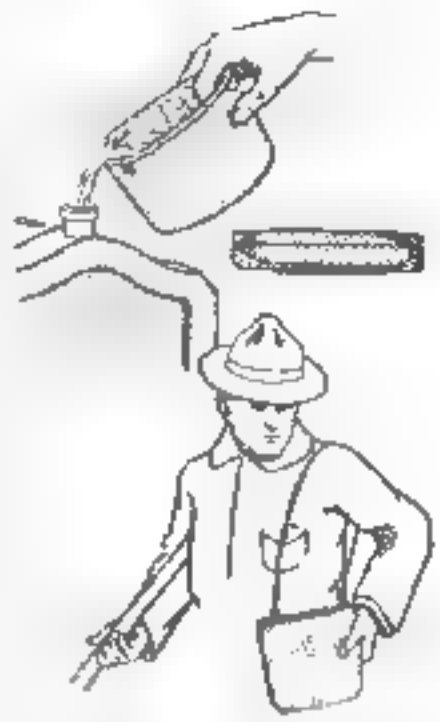


CROWDING one or two extra persons into a Ford car appears to be rather more of a habit than before. Time has shown that a little Ford touring car can be relied on to "ramble right along" with as many as seven people in it, and inventive geniuses are busy supplying additional seats. The accompanying illustration shows a neat, simple and very light seat, to be hung over the doors of the car. The hinges at the bottom of the hanging rods show that the seat can be folded flat. The device is finished in japan, with padded leather or pantasote seat. The hooks are also padded with leather to avoid marring the finish of the doors.

Beeswax for Cracks and Holes

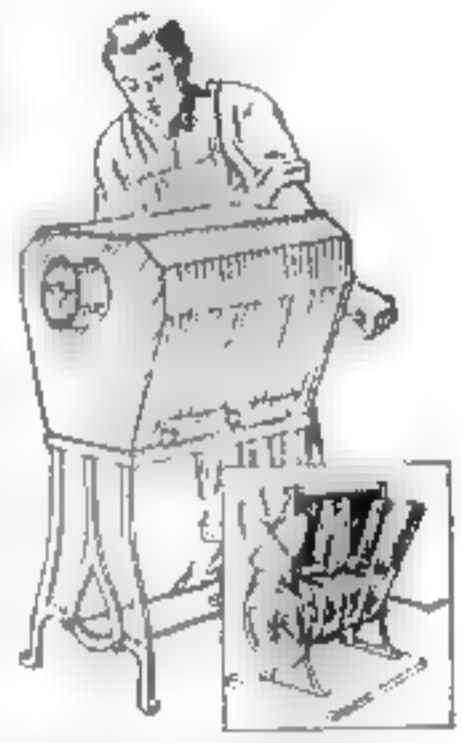
WHEN filling cracks and holes use beeswax instead of putty. Heat it until it is plastic and push it into the crack. Then sandpaper the wood around the crack and let the dust mix with the beeswax. When the wood is stained, the crack will be hardly noticeable.

This Folding Motor Bucket Is Also a Game Bag



A WATER bucket which folds up and may be put in the door pocket or under the cushions of an automobile is one of the most convenient of recent motor accessories. It is made of heavy brown waterproof canvas and holds over a gallon The only metal in the bucket is the top rim, which folds compactly, and when unfolded stays in position. To unfold, the rims are pushed out to the regular size and the bucket is immediately ready for use. It may also be used as a fish or game bag, by leaving it flat and fastening a strap or small rope in the loops on the side of the bucket. This latter fact makes it especially handy for a long tour

A Machine for Cleaning Blackboard Erasers



A MECHANICAL cleaner for blackboard erasers has been brought out which will entirely obviate the highly unpopular schoolroom task of beating the erasers on the window sills, with the unpleasant clouding of the room which accompanies this operation. The apparatus consists of several pivoted handles with erasers fastened at the upper ends, an upright screen and a rotating shaft fitted with cams. Rotated by a handle at the end of the machine, the cams force the handles outward so that they descend briskly upon the screen, thus driving out the chalk dust retained in the erasers. A fan whirling rapidly at one end of the screen blows the dust away from the operator

If You Only Have a Rope

SUPPOSE you are caught like a rat in a trap in a house on fire. Your only means of escape may be a dead wire, a loose rope, or sheets and blankets tied together to make a rope.

The correct way to slide down a rope

Would you know how to slide down the rope or wire like a fireman or sailor? You will very likely say, as sixty odd university students replied when asked that question: "Ah, that is easy. Anybody can slide down a rope."

But can they? Boys are usually as agile as monkeys, and more likely in an emergency to be able to rescue themselves than others, yet a recent test of boy scouts with a rope lowered from the first story of a supposedly burning building, proved that only two or three knew how to use a pole, a wire, twisted sheets or a rope in order to reach the ground safely.

Sliding down a rope, like many other things, is simple enough—if you know how!

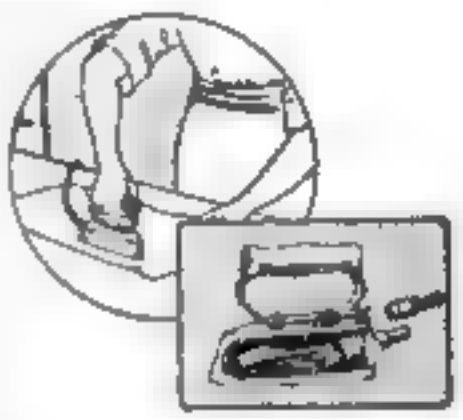
If you lower yourself by letting the rope or wire slide and slip through your hands or touch any part of the uncovered flesh, the motion and friction will sting and tear your skin beyond endurance. This will cause you to let go and may produce serious results.

By holding on with your hands and letting your weight go down, one hand over the other, you will not go far before you are too tired to support your own body. Disaster will be the price, because you will drop like a shot. Nor can you slide with the rope between your legs, because the swaying will make the rope slip or will jerk it from its clutch.

There is a right way, which secures to you almost the safety of walking on solid ground. You stand upright and put out your leg, say the right, and give it a turn around the rope. Next put the rope into the crook of your elbow and there hold it firmly.

Your hands and skin do not now touch the rough rope at any spot. You may slip down slowly or rapidly, but under complete control by bending or stiffening the body, to the security below. Your garments act as a shield to your flesh, and you have a fire-escape and rope-ladder fit for safety, stratagems or adventures.

A Bunsen Burner Flat Iron



AN Illinois manufacturer has placed on the market a novel gas flat-iron which employs the principle of the Bunsen burner to keep it at an even temperature and to eliminate any outside heating. Essentially, it consists of a hollow flat-iron, in the back of which is inserted a modified form of the simple and inexpensive burner. By its means the gas flame is directed down towards the point of the iron; and the intensity of the heat may be very easily regulated by the amount of air admitted to the tube attached to the back of the iron.

A Hair-Drying Comb

A COMB with a hollow back for receiving a hot iron is the essential idea contained in the illustration. The comb is the exception that the back is hollow. A handle with a heating iron is provided as a part of the device. When it is desired to use the comb for drying the hair, the iron is heated in a gas flame and inserted into the back of the comb. Gradually the heat is conducted to the teeth, which are made of steel. Stroking the hair with the warm comb readily dries it, and, the inventor claims, leaves it in a lustrous, soft condition.

That Mathematical Short Cut

Short Cuts in Arithmetic

THE principle described by Mr. Shourn in the November issue of the POPULAR SCIENCE MONTHLY as a "Short Cut in Multiplication," can be used equally as well in addition, subtraction and division, with slight variations. To use his figures in

Addition.

974205 — 33 — 6
84337 — 25 — 7
13 — 4
1058602 — 22 — 4

Subtraction.

974205 — 33
84337 — 25
8 —8
889928 — 44 —8

If the 33 and 25 were further reduced it would be 7 from 6, in that case 10 would have to be added to the six, and 1 subtracted from result, as below:

33 — 6 — 16
25 — 7 — 7
9
1
8

Multiplication.

974205 — 33 — 6
84337 — 25 — 7
42 — 6
821660587305 — 51 — 6

Division.

In division the division digits are multiplied by those of the quotient and to the result the remainder is added, these must equal the sum of the digits of the dividend.

Dividend — 974205 — 33 — 6
Division — 84337 — 25 — 7
Quotient —1146558 — 27 — 2 1/7
(7 × 2) + 1 — 15 —6
Dividend — 6

—L. E. F.

Be Sure You're Right

THOSE who read in the November number of the POPULAR SCIENCE MONTHLY the article entitled "Short-Cut Multiplication Proof" may be interested to know that the principle of the method there discussed may also be applied to the other three fundamental arithmetical processes.

As a simple example suppose we divide 25 into 375. Our answer or quotient would be 15. Now let us reduce each one of these figures to its lowest terms, which, according to this process, means adding the 2 and 5 in the divisor, making 7. Then 3 plus 7 plus 5 in the dividend equals 15, and 1 plus 5 in the 15 makes 6, the lowest term of our dividend; and 1 plus 5 equals 6, the lowest term of our quotient. To prove the problem all that is necessary is to multiply the lowest term of our quotient by the lowest term of our divisor. If our division was correct our answer will be the lowest term of the dividend. That is, in this case (quotient) 6 x (divisor) 7 equals 42; and as 4 plus 2 is 6, the same as the lowest term of our dividend, we know that our division was correct.

The following is an illustration of proving substraction:

5721 equals when the digits are added together 15
3545 equals when added 17, and 7 plus 1 equals 8
2176 equals when added 16, and 6 plus 1 equals 7

The same problem in addition would be:

5721 equals 15 equals..... 6
3545 equals 17 equals..... 8
14 equals 5
9266 equals 23 equals..... equals 5

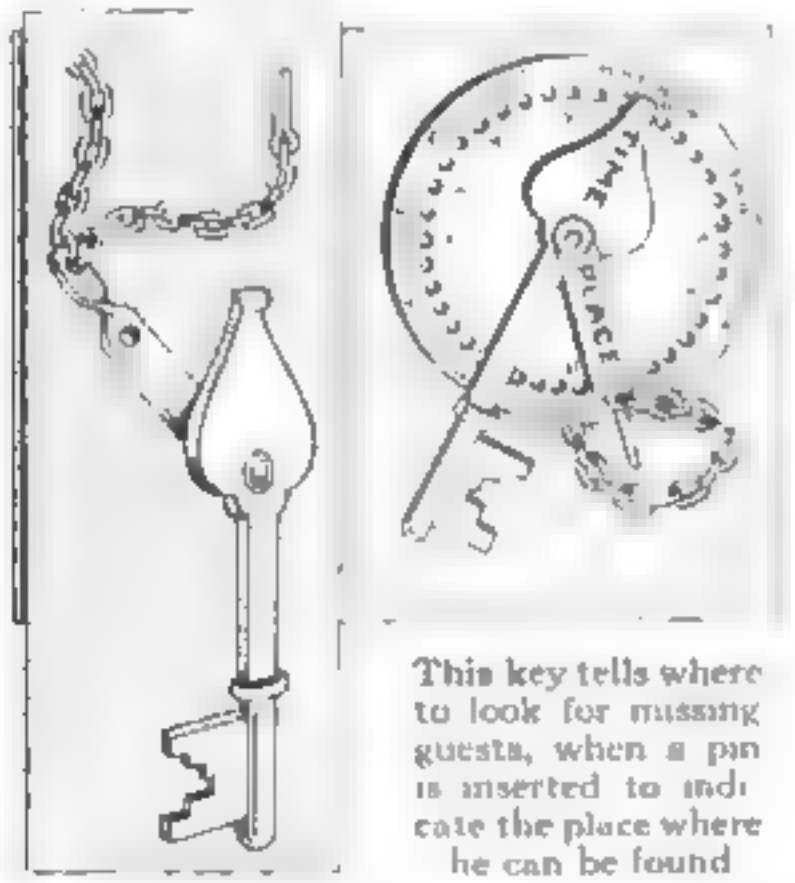
With a little practice one may become very proficient in reducing the numbers to their lowest terms, thus making the process valuable for those who have to check over their own work. Try it.

—M. A.

Hotel Keys Which Take the Place of Shouting Call Boys

NO longer will hotel clerks have to "page" the corridors, lobbies and bars when a visitor asks for a guest who cannot be found in his room. It will only be necessary to take the key which Mr. Jones has left at the desk, and after a glance say, "Mr. Jones may be found in the grill room."

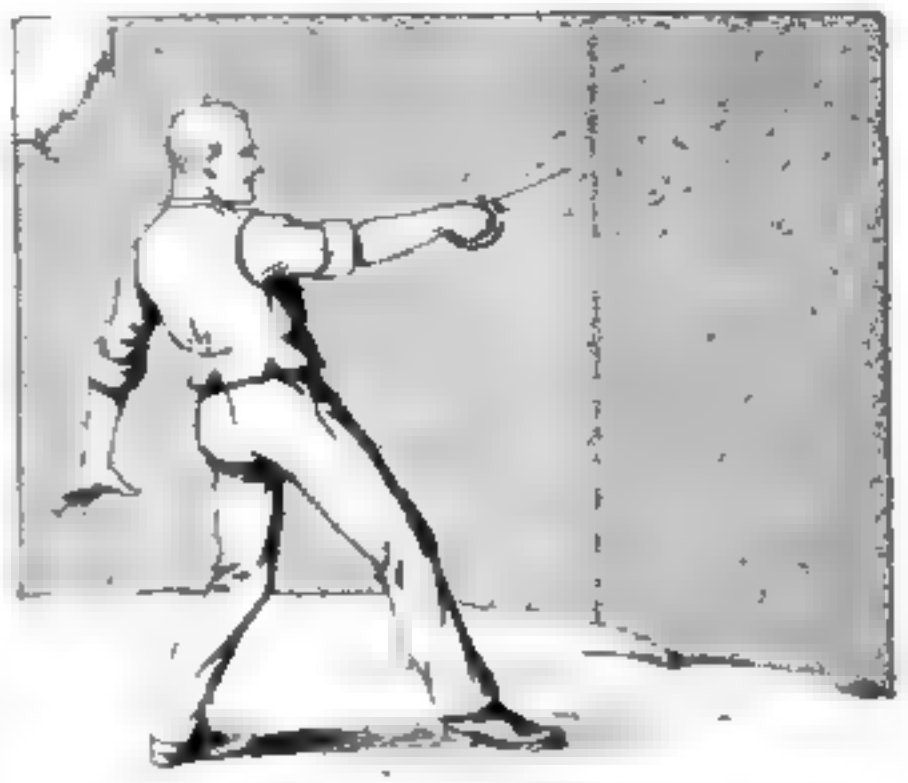
The labor-saving device which will make this possible is a novel key tag which has recently been patented by a Chicago inventor. The tag, on which the number of the room is stamped, is oval, and is imprinted with a clock face. By means of a pin in the center of the tag the key may be fastened so that it will act as the clock hand, indicating the approximate time when the user expects to return. On the outer edge of the tag are a series of small holes. Near these are stamped the names of the various public rooms of the hotel. Another pin is attached to the tag by means of a light cord or chain, and this may be placed in any of the holes, indicating the place where he may be found



This key tells where to look for missing guests, when a pin is inserted to indicate the place where he can be found

Water That Cannot Be Cut

A FACTORY in Grenoble, France utilizes the water of a reservoir situated in the mountains at a height of two hundred yards. The water reaches the factory through a vertical tube of the same length, with a diameter considerably less than an inch, the jet being used to move a turbine. Experiments



A stream of water under high pressure will break the blade of a sword if an attempt is made to cut it

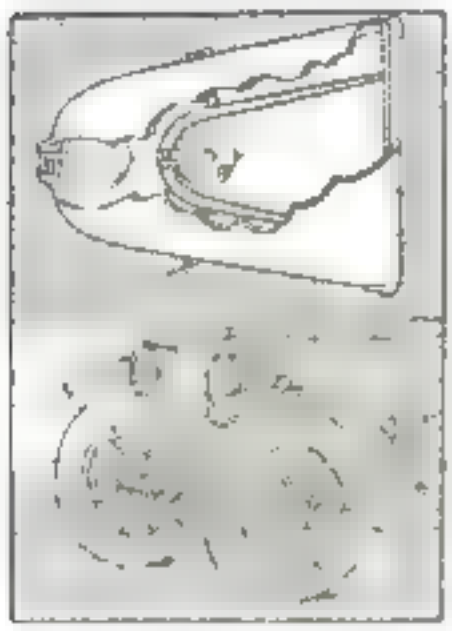
have showed that the strongest men cannot cut the jet with the best tempered sword; and in some instances the blade has been broken into fragments without deflecting a drop of the water, and with as much violence as a pane of glass may be shattered by a blow from an iron bar. It has been calculated that a jet of water a small fraction of an inch in thickness, moving with sufficient velocity, could not be cut by a rifle bullet.

The engineers of some big water power projects of the Far West are willing to wager that a two hundred pound man, swinging a four-pound ax with all his might, cannot make a "dent" in the water as it emerges from the nozzle at the power house. Burying an ax in a stream of water looks like child's play, and the average two hundred pound visitor is likely "to bite." He invariably loses. So great is the velocity of the water emerging from the nozzle in these modern power plants that an ax, no matter how keen its edge, is whirled from the hands of the axman as soon as it touches the water. The water travels under a pressure exceeding 500 pounds to the square inch in many instances, and no power on earth can turn it off at the nozzle, once it gains momentum. It has the same effect on one's fingers as a rough emery wheel, and will shave a plank with the nicety of a razor-edged plane. When, as frequently happens, it is necessary to shut down a power plant operated by one of these streams, the nozzle is deflected by means of a powerful set of gears.

What's New in Patents

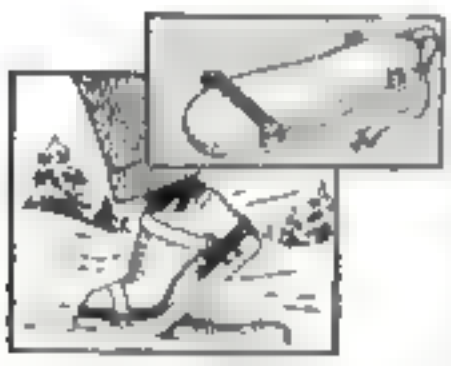
Little Inventions to Make Life Easy

A New Headlight Dimmer



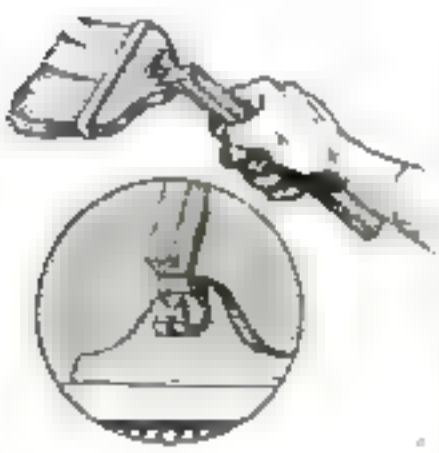
A SMALL searchlight is nested in one of an ordinary size, providing two complete headlights, one within the other. The larger one, when lighted, throws its beams in an anular ring of light past the headlight which has been nested therein. This makes a dim light. To make a brilliant light, both are illuminated at the same time.

Keeping Your Sole Warm



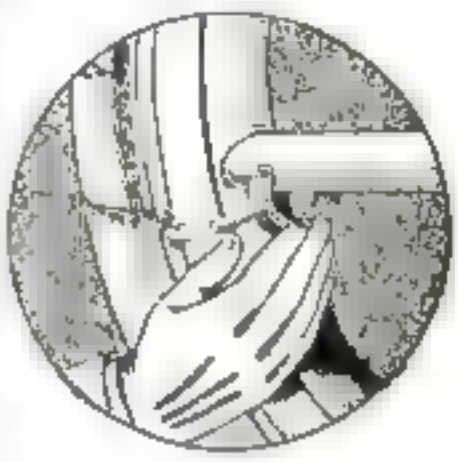
A LAYER of thick felt or rubber is sewed to a frame made of a resilient material, and shaped to follow the outline of the sole of a boot or shoe. At convenient points on the outside edge of the attachable outer sole are sewed projections or loops through which may be passed straps for securing the outer sole to the sole of the shoe.

Adjusting a Brush to Its Handle



A DETACHABLE and adjustable handle is fitted to the standard form of brush by means of a slotted fork and held to the brush by means of a bolt and a winged nut, which may be tightened or loosened by the fingers. By means of this fastening, the handle may be secured to the brush at any desired angle, or it may be removed at will

For Applying Chains to Wheels

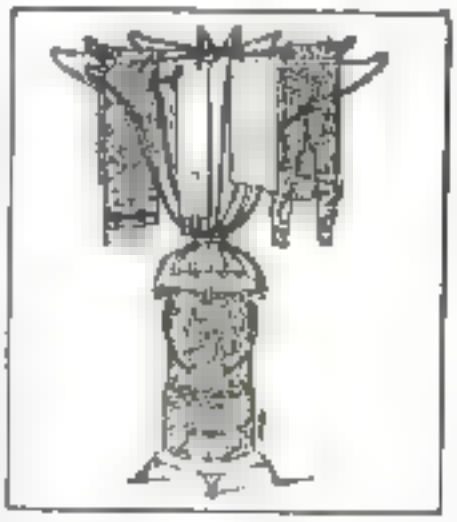


A BAR, having a central spring clip designed to grip the spoke of a wheel, is provided with two hooks on each end. In applying anti-skid chains to the wheel, after adjusting the clip, the ends of the chains are each engaged on the hooks, which are stationary, and the chains are thus held firmly in position.

An Egg-Tester and Mailing Tube Combined

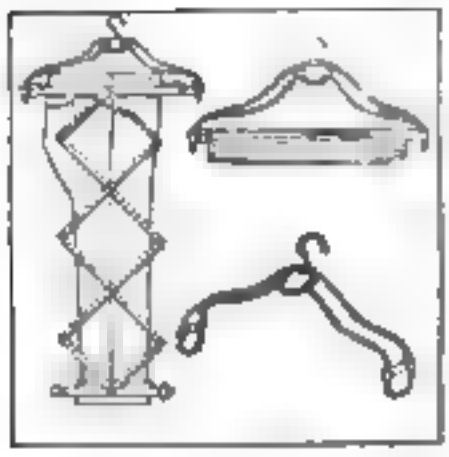
A SHEET of paper-board is rolled so that it will be somewhat tapered. On the larger end, the tube is so cut that it will fit the size of an egg held against it. A circular or other piece of printed matter may be mailed in this tube, and the recipient may use it to test eggs, by pressing an egg against the end and looking toward the light through the smaller end.

A Clothes Rack Dryer



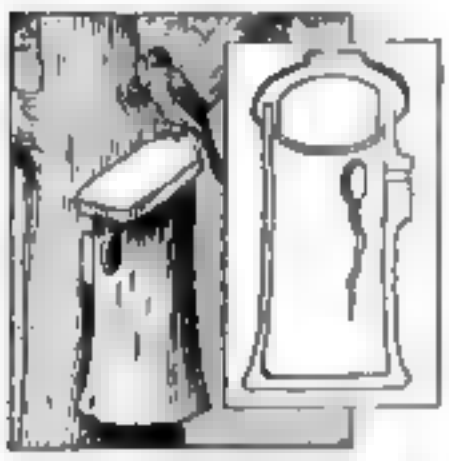
A NUMBER of heavy wires are fitted with hooks at their lower ends and sliding rings at the center and upper ends to form a collapsible clothes rack which can be fitted to an oil heater. By the sliding of the retaining rings, the device may be disengaged from the stove, collapsed, and stored in a small space.

Combined Coat Hanger and Trousers Stretcher



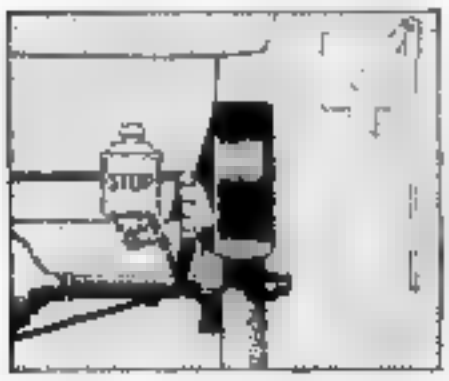
A CLOTHES hanger and trouser hanger are connected by a device which is commonly called a "lazy tongs." When the trousers have been hung on the device, the tongs are stretched as far as possible and locked, thus holding the trousers stretched. A coat and vest may be hung on this device at the same time by making use of the clothes hanger which forms the uppermost section of the apparatus.

Making it Easy for the Birds



A CYLINDRICAL bird box is made of fire-clay or pottery and is fashioned on the outside to resemble the trunk and bark of a tree. A slanting roof, which projects well above the walls of the house to prevent the leakage of rain or water into the house, is provided with deep flanges to hold it securely in place. A circular hole is made in the side near the top for the free passage of the birds, and on the inside is a climbing strip leading from the bottom to the side opening near the top to aid young birds or injured ones to reach the opening

A Simple Signal for Automobiles

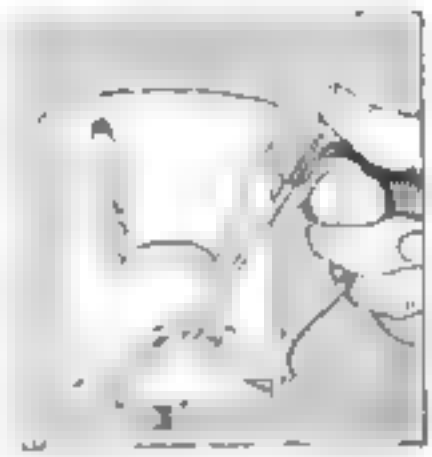


ON one side of the rear light is marked the word "Stop." The light is mounted on a pivot, being actuated by a rod connected with the brake rod. When the brake is moved by the driver, the light turns, exposing the warning signal to the rear.

Keeping Shampoo Soap Out of Your Ears

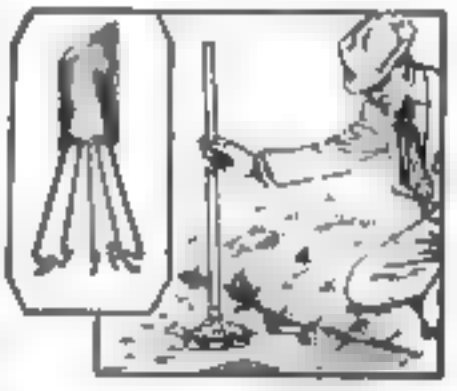
TWO ear protectors are held in their proper places by means of a resilient metal band fitting under the chin. Passing over the top and front of the protectors is a trough to catch liquid which might fall from the hair while the latter is being shampooed. The liquid passes over the top and is guided downward into the bowl, or if it falls against the front of the protector it is guided downward into two small cups or retainers which are suspended from the front of the protectors.

A Shaving Mug with a Soap Pump



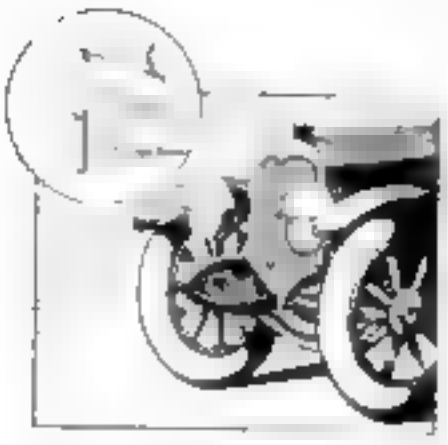
A SHAVING mug is made with a false bottom to contain liquid soap. Passing into the soap reservoir is a plunger which, when pushed, allows a sufficient quantity of soap for one shave to pass into the water reservoir.

Snapping the Snapping Turtle



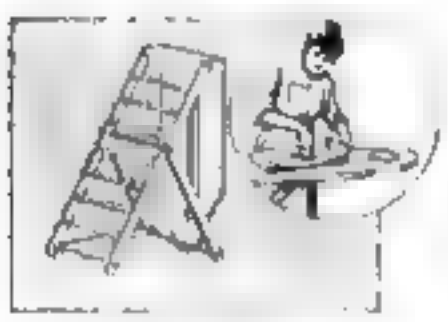
A NUMBER of resilient wires are attached to the end of a long pole. Each wire is provided at its lower extremity with a hook which is first bent inwardly and then outwardly. In use, when a turtle or tortoise is seen crawling upon a river bed, the operator, with a quick downward movement of the pole, forces the free ends of the gripping wires or fingers downward upon the shell back of the reptile. The wire fingers spread outward until they ride over the edge of the shell back. The shoulders formed by the shape of the wire fingers engage under the shell and grip it tightly.

A Headlight Dimmer Operated from the Seat



A HOOD or shield, formed of a single piece of metal, is fitted to a pivot on each side of an automobile headlight and equipped with an arm leading to a controlling lever. The shield, in its normal position, rests above the lamp, but when the control lever is actuated from the driving seat, the shield pivots to the front of the lamp and deflects the rays of the searchlight, so that the blinding light will not dazzle an approaching pedestrian or driver.

A Stepladder and Ironing Board

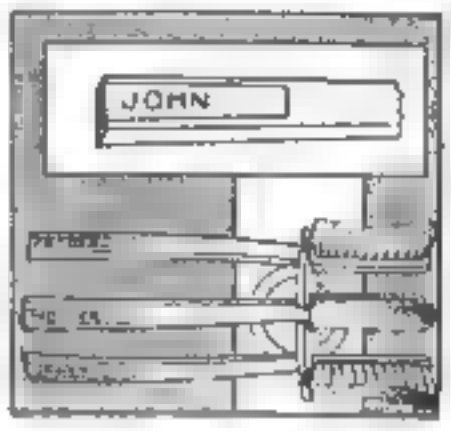


A DEVICE that will appeal to the housewife who desires compactness is a step-ladder attached to an ironing board by means of two pivots. A brace is secured to the legs of the ladder and engages the bottom rung and holds the ladder in place. A similar brace makes it into an ironing table. The combination when not in use can be folded together to save storage space.

Increasing your Grip on the Golf Club

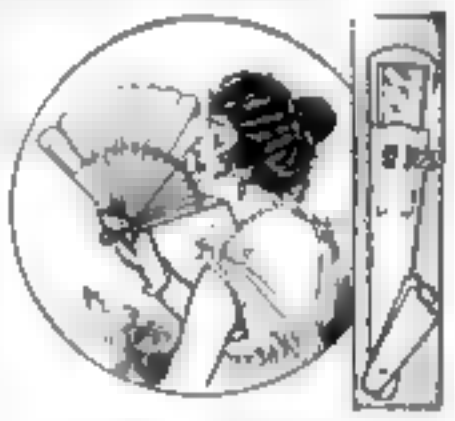
THE palm and fingers of a glove are provided with a number of gripping surfaces composed of flexible leather. These are cut to such a shape that when the glove is encircling a golf-club the maximum amount of gripping space is in proximity to the club, thus insuring a firm grip. On the back of the glove are numerous ventilating holes, which also add to the flexibility of the glove.

It's a Wise Man That Knows his own Tooth Brush



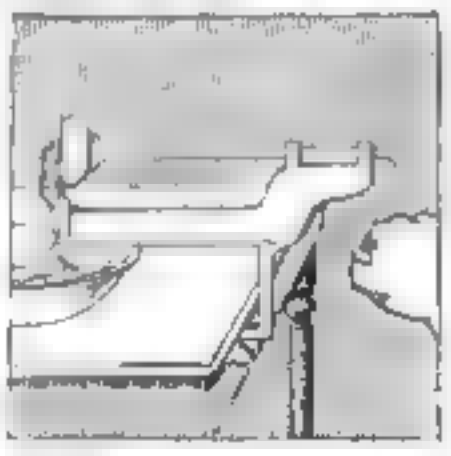
THE handle of a tooth brush is made of a transparent material and is provided with a deep longitudinal slot. In this slot may be slipped a label upon which is marked the name of the owner of the tooth brush. A plug is furnished to seal the open end of the slot, making the interior waterproof. By means of this device the name of the owner is permanently placed upon the instrument, and is not made illegible by handling or by the influence of water.

A Sop to Feminine Vanity



A FAN is made with a small mirror placed on the inside of one of the end blades. A small button on the same blade is designed for engagement with a hole in the adjacent blade. When the button is engaged in the hole, the mirror is concealed behind the adjacent blade, which does not open, with the rest of the fan. When it is designed to use the mirror, a slight pressure upon the end blade will free the button and expose the hidden mirror.

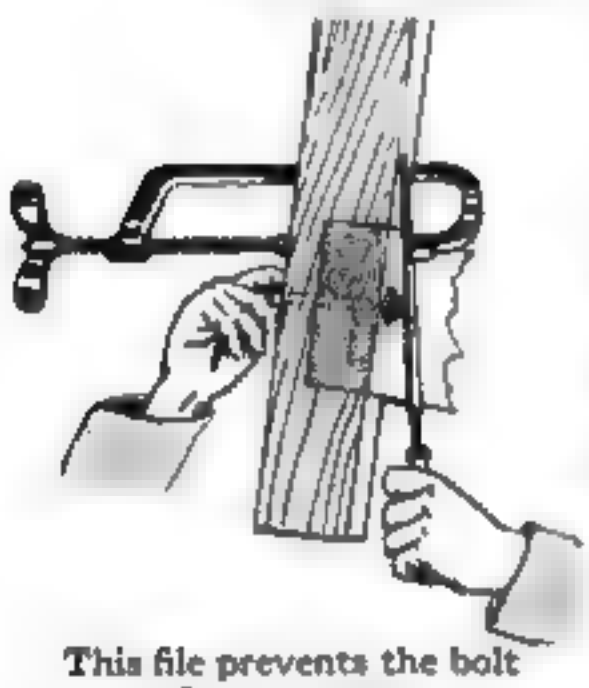
Making Potato Chips by Machine



A THREADED rod is set on a stationary arm which is provided with a clamp and set screw so that it may be secured to a table. On the arm, opposite the threaded arm, is mounted a pin and a knife blade. A potato is placed upon the pin, and by means of a handle the threaded arm is rotated, thus pushing the potato against the knife. In the process of turning the handle, the knife cuts the potato into strips suitable.

For Practical Workers

To Prevent Bolt from Turning When Unscrewing Nut



This file prevents the bolt from turning

THE bolt will often turn in unscrewing nuts, and should it be a carriage bolt difficulty is often experienced in unscrewing the nut at all.

The accompanying illustration shows a very simple method of preventing the bolt from turning, by simply clamping a coarse file over the head of it, as indicated.

Saw Box

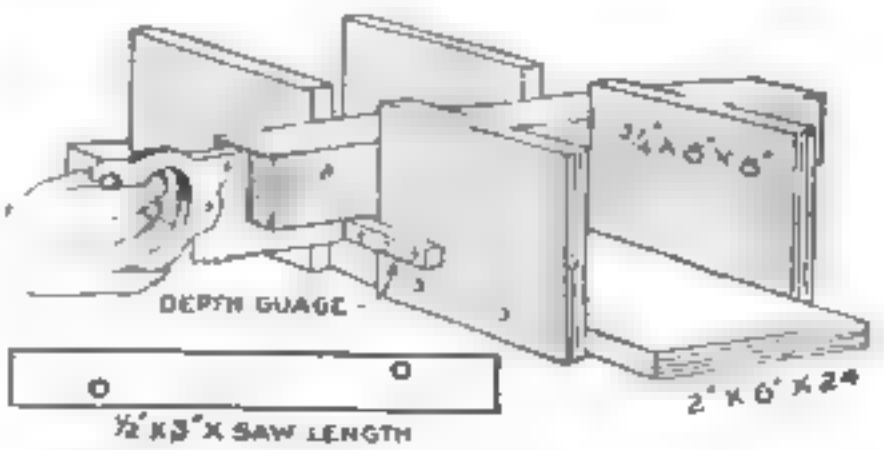
THE saw box illustrated is one which has proven itself well worth while. In cutting a large number of pieces to the same length it was found that the old-fashioned box soon became inaccurate, due to the contact of the teeth of the saw with the edges of the guides. To obviate this trouble and secure a more permanent and serviceable box this one was designed.

The drawing requires very little explanation. Hardwood, preferably maple, is used throughout. The saw is first equipped with the two strips of wood, one on either side. These are bolted on to the saw with two ¼″ x 1″ stove bolts, heads and nuts set flush to allow the saw to pass between the vertical guides. The holes may be readily punched in the saw by means of a good punch. Hold the saw on the end grain of a block of hardwood and keep the holes at least ¾″ from the edge, in order to avoid cracking the saw.

As the saw will be found a little thicker at the heel than the point, as well as at the teeth, than the back, the boards will have to be dressed down to bring them the same thickness at every point, after they have been bolted on. Be quite certain to take the same amount from each board.

Next work out the parts for the box and carefully assemble the boards at one end. Place the saw in position and assemble the boards on the other end, being certain that there is just enough play to allow the saw to move freely, but with no shake. A little beeswax or floor wax on all the guides will keep the saw moving freely and easily and will also prevent wear.

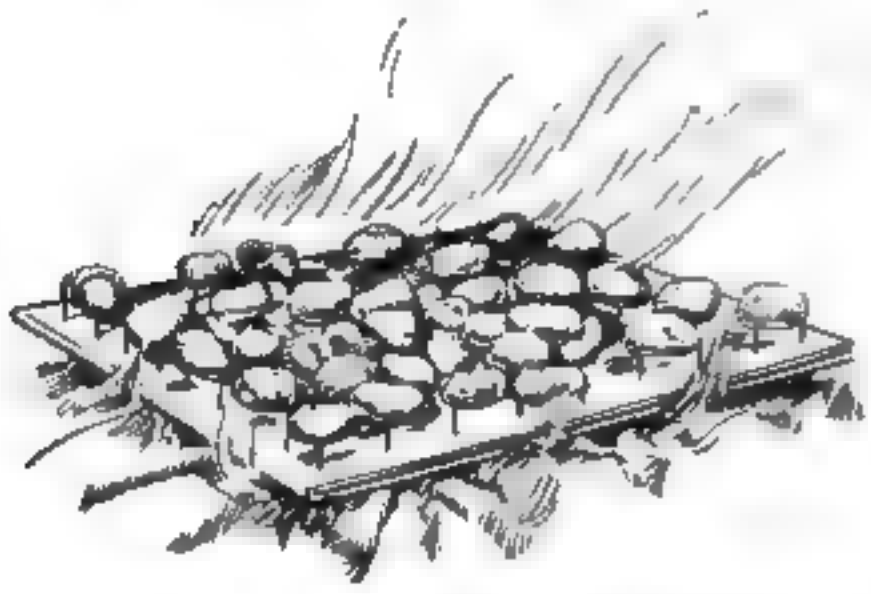
An excellent depth gage can be arranged as suggested in the sketch. A fine tooth saw will give best results. The saw is always available for other work by removing the screws and taking off the boards. The holes in no wise interfere.



This saw box will be found more permanent and serviceable than the old fashioned box

Potato Roaster for Campers

A POTATO roaster for camping parties may be made from a sheet of stiff sheet metal—iron will usually be



The potatoes are held on nails, and the heat circulates evenly

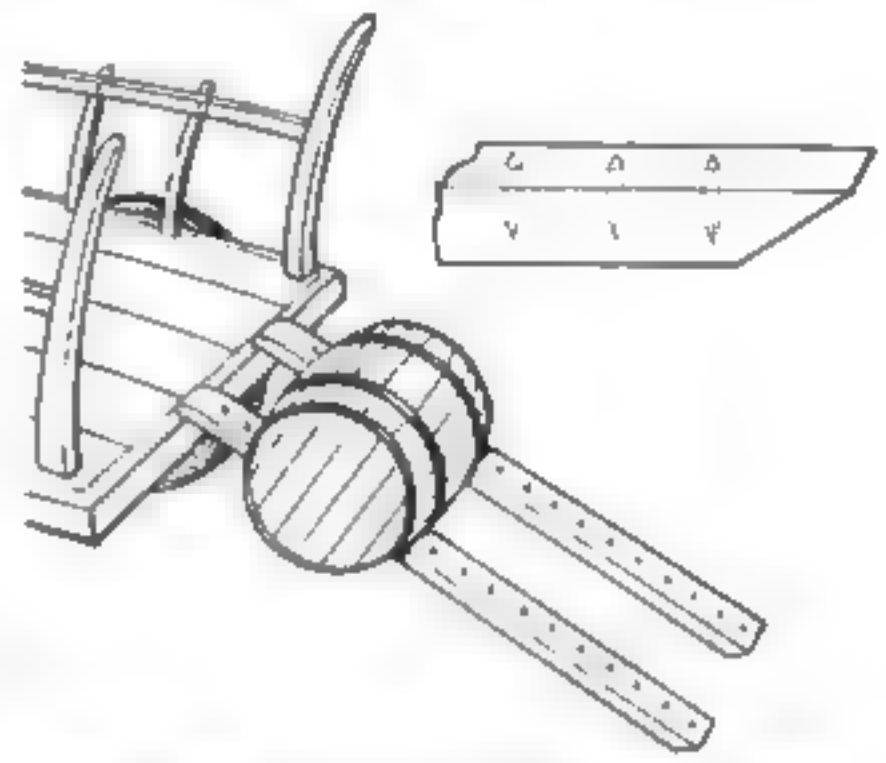
the handiest—through which a number of nails spaced equally distant are driven. The potatoes are pushed upon the nails and the loaded tray lowered over the glowing coals of the camp fire. The heat circulates about the potatoes evenly; so they are roasted uniformly

An Electrical Peddler Chaser

PROBABLY the greatest source of annoyance to the housewife is answering the door-bell for agents who peddle things not worth buying.

A little device shown in the accompanying sketch will save her much annoyance. The little box is placed at the front door over the bell button on a level with the eye. It contains a sign which shows through a small window. The sign is operated similarly to an old-fashioned window shutter by an electro-magnet; when not in use the two leaves of the shutter lie horizontal as in the right-hand drawing. In this position the sign cannot be read. The leaves are hinged to a double-armed rod, which, in turn, rests on a long lever, the lever being pinioned very near the magnet on a small bracket. This increases the lift of the magnet, so that about a quarter of an inch of movement on the left end will give about an inch and a half at the right, which is sufficient to bring the leaves in a perpendicular position and to exhibit the sign, which is drawn back by gravity.

A push button is situated at a point in the house from which a view of the front walk or porch may be obtained; or, if the front door contains a glass, near the kitchen door. When an agent rings the bell the button is pressed and he is dismissed by the sign. He can't argue with this "Agent Chaser."



This sign is guaranteed to rout any peddler

The nails have their heads filed to a point, and prevent the casks from slipping

Prevents Casks Slipping While Unloading

OILY barrels or casks give truckmen much trouble when they are loaded upon wagons or drays, owing to the tendency of the unwieldy object to slip on the ways which are placed between the truck or wagon floor and the sidewalk. This difficulty can be removed by driving a row of stout nails into the ways and filing the heads to a sharp point. While not seriously marring the face of the casks, the points prevent them from slipping.

An Electric Toy Semaphore

AN electric semaphore, if used in connection with a toy electric railway, will be interesting as well as instructive.

Its construction requires an electromagnet, (F) Fig. 1, pulling down an arm (A) when the magnet is energized The arm is provided with a small extension, so that it automatically shows the regulation colored lights at either position of the arm. When at right angles to the standard it is supposed to signify "Stop" or "Danger," and a tiny red light shows. When hanging down at 45° from the standard it signifies "Clear Track" and only a small white light is seen.

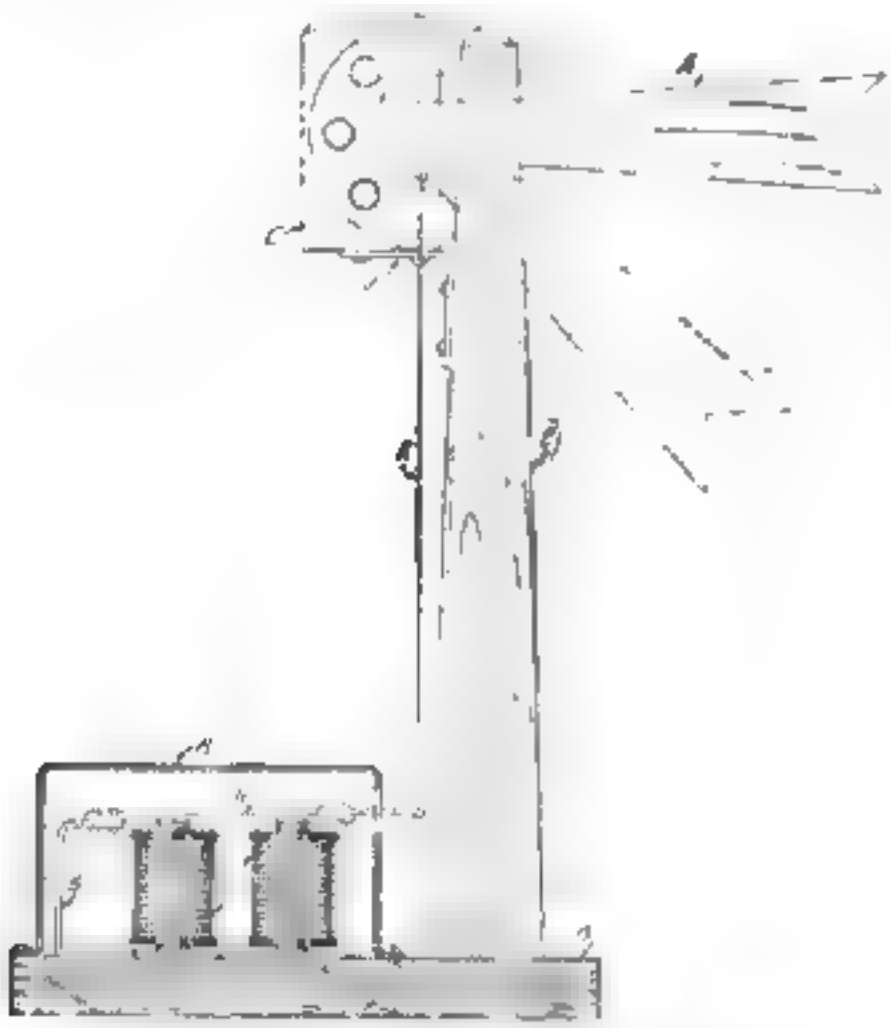


Fig. 1. The semaphore, if properly painted, has a very realistic appearance

Fig. 2 is the detail of the semaphore arm, which is made of light sheet brass or aluminum. The dimensions explain it thoroughly. The small lip which is to be bent outwards at right angles is the part to which the string (K) is attached.

Dimensions for a magnet cover (B) that will fit over a magnet taken from a medium sized bell or buzzer are shown in Fig. 3. This should be made of light sheet brass or aluminum. Small lips are provided which are bent in and soldered or riveted to an adjoining side. The dotted lnes indicate where the metal should be bent. No dimensions are given for the small holes, their size depending on the size screw used to fasten the cover to the base.

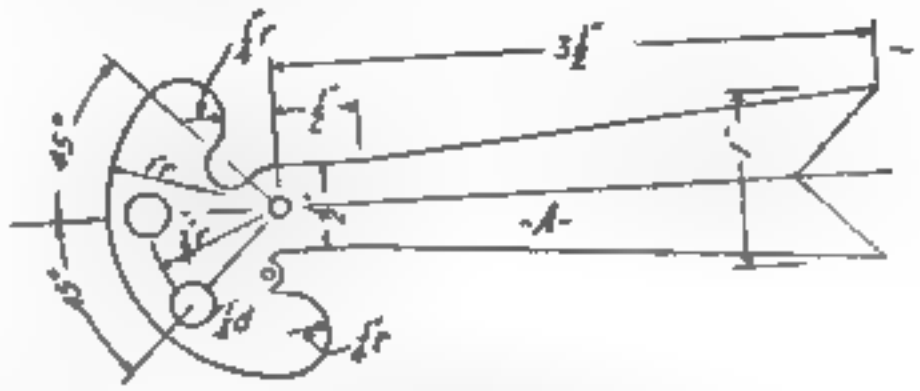


Fig. 2. Detail of the semaphore arm, showing dimensions

The lamp (C), Fig. 4, is made of hard wood, 1⅛" square, into which holes are bored as shown in the figure. Small 3½ volt flashlight lamps fitted into miniature sockets are put into the ½" hole as far as they will go. The end is then filled with putty so that it is lightproof. The ⅜" holes are covered with tissue paper, the top with white and the bottom with red. The lights may be connected in multiple or series, depending on the voltage of the current. If small telephone switchboard lights and the opals which fit into the switchboard sockets can be procured the holes may be bored smaller and a much neater effect secured

The base (D) and the standard (E) are made of hard wood. The base should be about ½" thick. In Fig. 5, the plan of the arrangement of the parts is shown. The four small holes shown

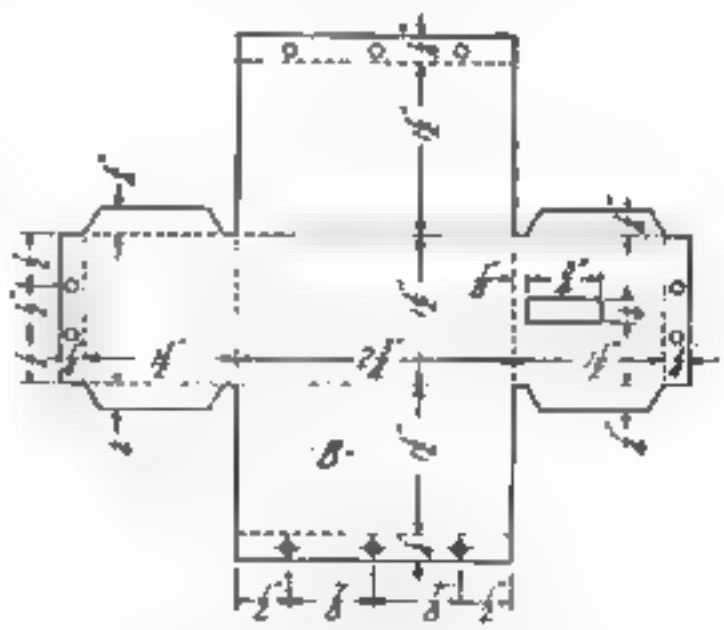


Fig. 3 Dimensions for cover to fit magnet taken from bell or buzzer

are for binding posts. Each element has its own set of binding posts. The reason for this is that some experimenters have a step down transformer which would be suitable for the lights but cannot be used in connection with the magnet.

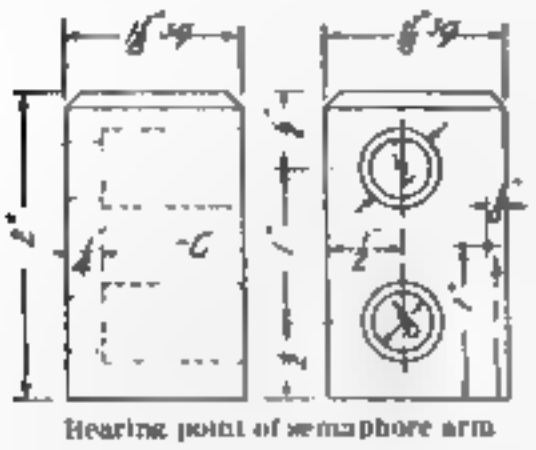


Fig. 4. Diagram showing construction of lamp

No dimensions are given for the spring (G), armature (H), or projection arm (Fig. 1), their size depending on the size magnet used. The spring (G) should be made of some spring metal, such as german silver or phosphor bronze. The armature (H) is made of soft iron and the projection arm of aluminum. The spring and arm are riveted to the armature.

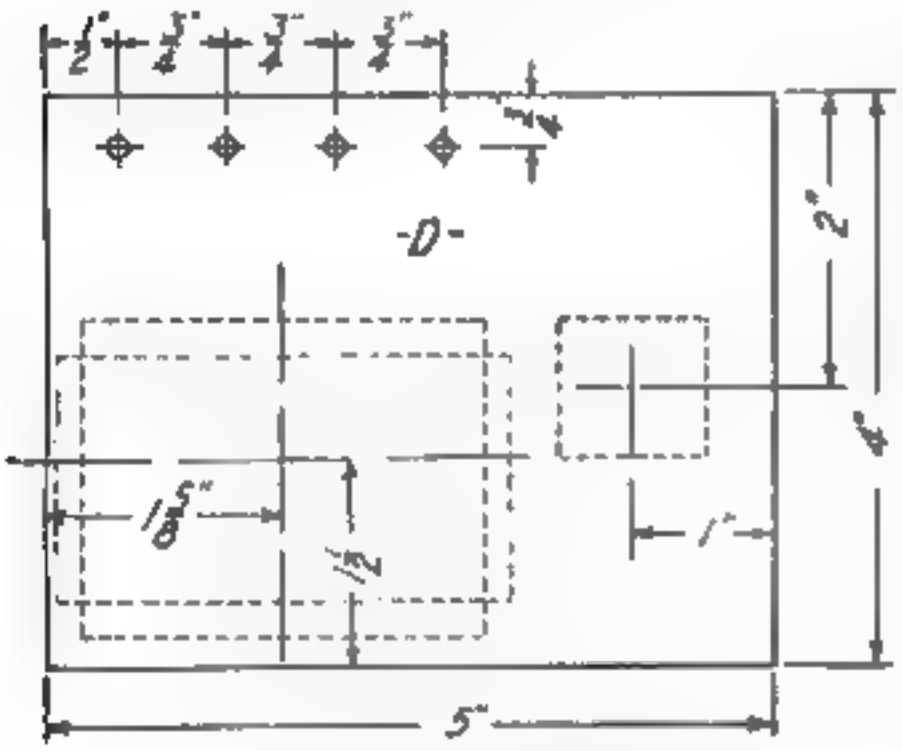


Fig. 5. Plan of arrangement of parts, with dimensions

An angle arm (J), holds the lamp to the standard. It should be about ½" wide and each arm about 1" long.

The string (K) attached to the projection arm is the means by which the semaphore arm is moved when the armature is pulled down by the magnet. If a light brass chain is used in place of the string, the appearance is more realistic.

Fig. 7 shows the wiring diagram when used with one source of current. The key is a strap key or push-button,

placed at a distance from the semaphore. In Fig. 1, the arm is shown with the current passing through the magnet.

When completed and assembled, if the cover, base and lamp are painted black, the standard painted white and the semaphore arm painted red with two white stripes as shown it gives the semaphore a very realistic appearance.

The semaphore need not be entirely electric as the semaphore arm can be constructed so that it will move with a lever instead of an electromagnet. In such a case, its construction will be much simpler than when electricity is used

Fig. 6

Saving Time in Tracing a Design

NEARLY every worker, from the lady embroiderer to the machine shop designer, at some time has use for a symmetrical design, yet they usually go to the trouble of drawing each side out, or tracing one side. A far quicker and easier way is to use the following draughtsman's method:

Draw one half of the design out on tracing paper, or any strong tissue paper. Fold this over on top of the blank half, being careful that the crease comes exactly along the center line of the whole design. With a silver half-dollar, pass over the top of all using a rapid to-and-fro stroke. The design is now reproduced perfectly on the other half of the paper. For this work the pencil should not be too hard, F or B, or a common No. 2.

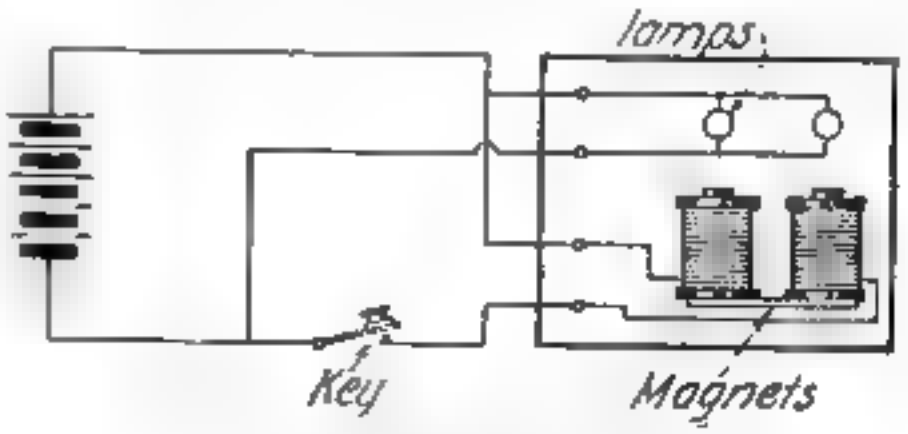
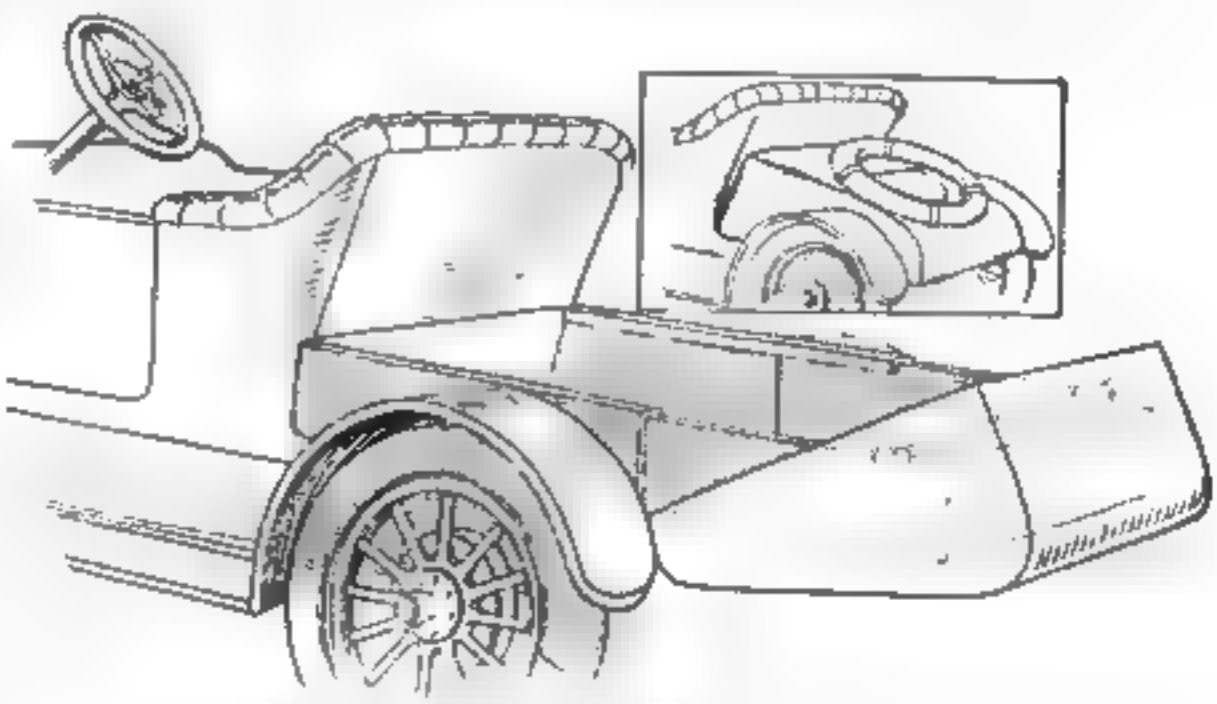


Fig. 7. Wiring diagram when semaphore is operated with batteries

Enlarging a Runabout's Capacity

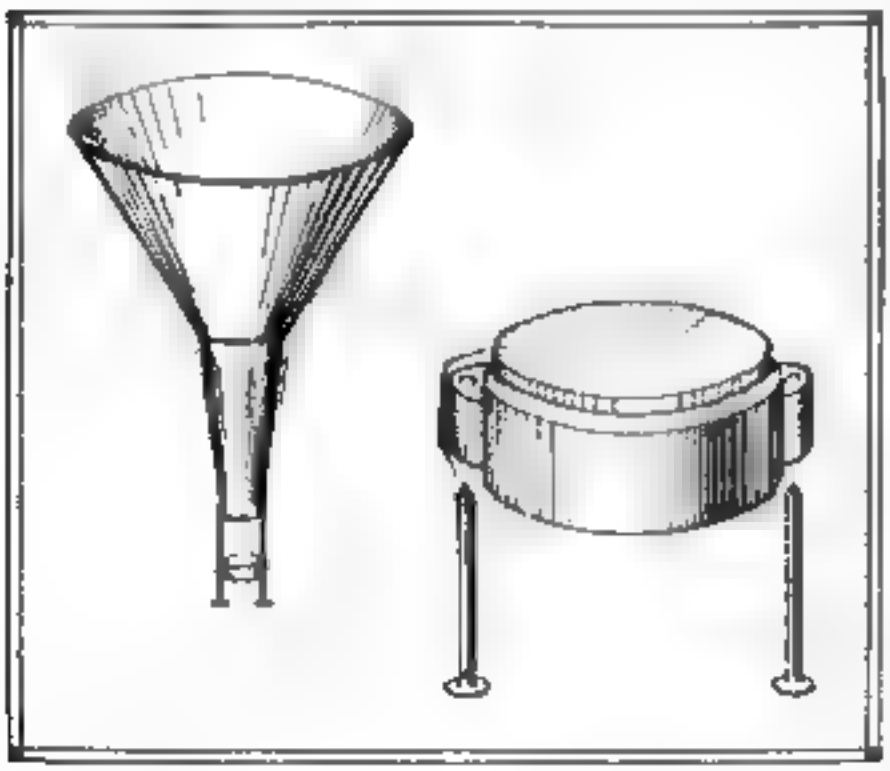
THE torpedo extension with which most runabouts are built is often inadequate for carrying packages or bundles of more than ordinary size. With some extra lumber, the capacity of a small automobile may be considerably increased, as shown in the sketch. An extra box is so constructed as to get telescopically into, and slide easily in and out of the main box on the rear of the car. When the hood is lifted and folded back, this extra drawer may be extended into the hood and supported by it. In this way an extensible box is furnished which considerably increases the capacity of a runabout without decreasing its strength or detracting from its appearance



The extensible box is easily made and greatly enlarges the capacity of the car

A Non-Spillable Funnel

A FUNNEL which will cease flowing automatically when the vessel into which the liquid is being poured reaches a certain height, can be devised by attaching a metal float to the tapering funnel-tip. The float is a small metal cylinder closed at both ends. Small brass tubes should be soldered on opposite sides of the float, as indicated in the drawing. Nails which will fit loosely in the tubes (to give the float free play) should be soldered at their points to the tip of the funnel, with the float in place.



When the funnel is filled the float rises and stops the flow

When liquid is poured into the funnel, it will flow past the float until the vessel is nearly filled, whereupon the float will rise and check the funnel's discharge The funnel can then be withdrawn quickly, so that little or no liquid is lost.

Mat-Making for Photographers

TAKE a few spoiled plates and clean off the film. Cut off four pieces from a roll of passepartout, one for each edge of glass. Paste these on the glass along the edges, leaving an opening in the center of the glass a little smaller than the films or plates.

In using this put the mask in the printing frame first, lay the film or plate on top, and print in the usual way.

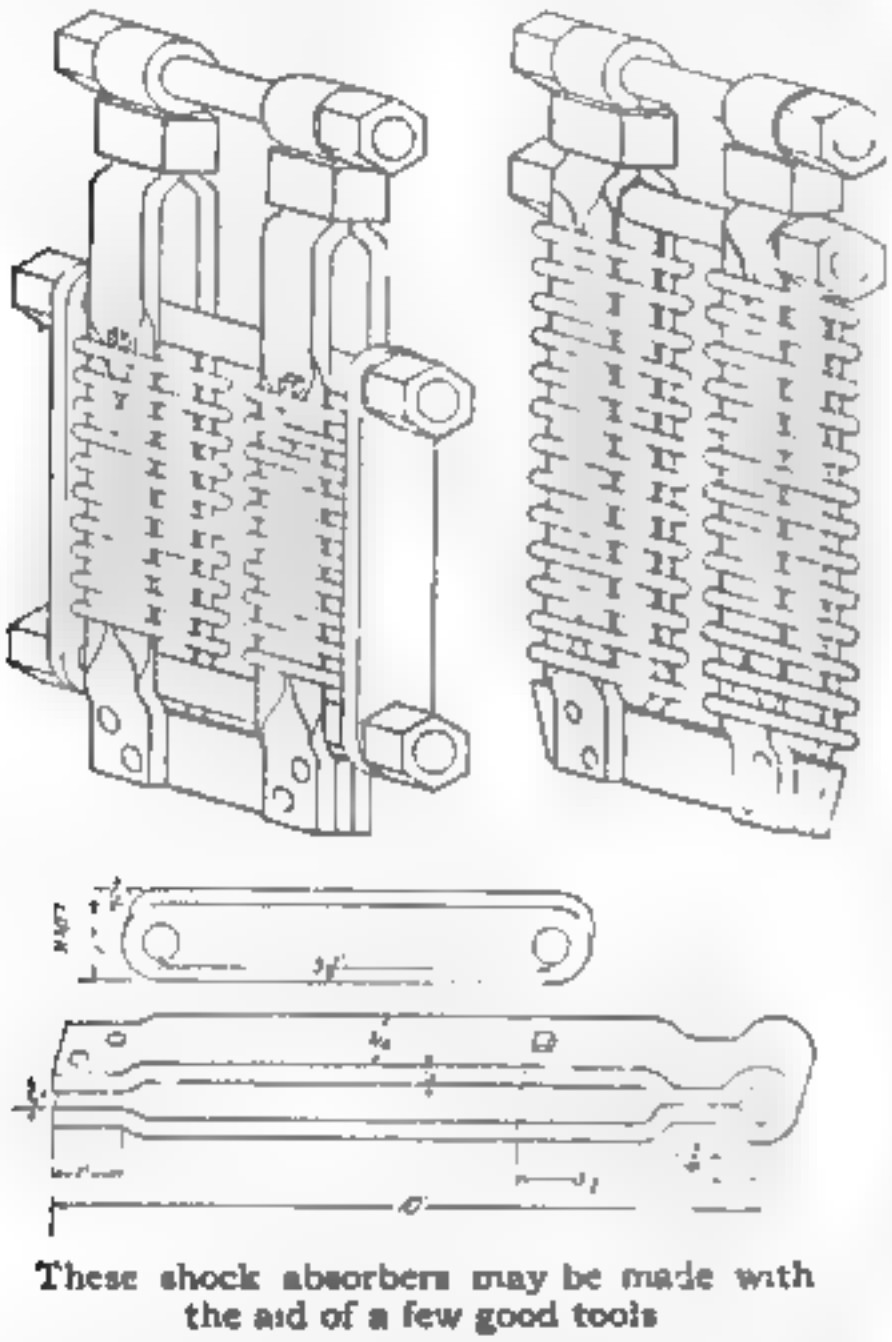
By making a number of masks with different size openings in the center, different size films or plates can be printed.

If a mask of special design is wanted, paste the loose mat on the glass, as it saves time, and also prevents the mat from being lost, torn or creased.

Passepartout tape can be bought at any art store for 10 cents a roll of 12 dozen yards. This will make all the different size masks wanted, and there will be enough left over to passepartout a number of prints.

Shock Absorbers

AFTER a season without shock absorbers on an automobile and a season with them, a driver will be thoroughly convinced of their worth. Here are given sketches and descriptions of a type which can be built by anyone handy with tools. The advantages of shock absorbers may be summed up in three words: comfort, speed and saving. With shock absorbers a light car equals in riding quality cars of much greater weight and longer wheel base. A speed of five to ten miles more per hour is practicable. The



These shock absorbers may be made with the aid of a few good tools

saving is in the general wear and tear on the machine and especially in the tires.

The absorbers shown here are fairly simple in construction, requiring no welding or other difficult forging operations and but the simplest of machine shop operations, that of drilling

The rear absorber is somewhat simpler than the front one. Eight of the brackets shown are worked up. The hole in the top is formed by bending the piece of ¼" x ¾" mild steel around the proper size pin. The size of this hole is not given, as it will vary, in some cases being ½" and in others 9/16", depending on the make of car. This is a matter which the maker must determine before ordering the stock. Cold rolled steel is used for all bolts. The width of the spring leaf will determine the length of the bolts.

After the brackets have all been bent up a clip is placed around the neck of each. Some of the ¼" x ¾" stock is used for these. The clip is first made U-shaped and then placed over the neck while hot and the ends clinched or bent over. These ends should be just long enough to come together when bent over. The cross bar at the bottom of the rear absorber is made long enough to support the side of the springs. This bar is made from ¼" x 1" stock. The bottoms of the brackets having been bent to shape, the cross bar is held in position and the holes drilled. Rivets of ¼" are used to hold these parts together, but before fastening finally the springs must first be provided and fit on the brackets. It is best to round the corners of the brackets to form a better support for the spring as well as to prevent the coils becoming nicked, thus causing them to weaken and finally break

Owing to the method of attaching front springs in use on almost all types of cars, the design of the front shock absorber must be radically different from that of the back. Here the pull is up instead of down, so the coil springs must be held rigid at the upper end and links used to transmit the shock down and under the bottom ends of the coil springs, which in this case are the free ends. A study of the sketch will show the construction clearly. In order to prevent the springs coming up over the bracket too far a set screw is placed in each side of each bracket as suggested in the sketches. A ¼" set screw is heavy enough for this. The link is detailed in the sketch, except the size of the holes which will be determined by the size of the holes in the spring. The bottom cross bar is cut off even with the edge of the bracket instead of allowing it to extend as in the case of that on the rear absorber. The corners are again ground round before assembling the springs in place permanently.

The weight of the car will determine the size wire to be used in the coil springs; 3/16" for the front springs and ¼" for the rear ones is about right for a car in the 2,000 pound class. This is figured for a touring car where five passengers are to be carried. In the case of the roadster the rear springs could be of one size smaller wire. In the case of cars materially heavier the size of the wire should be increased In order that the springs may carry the load properly they must be made 1" longer than the place they are expected to fill. This means that when they are assembled in the finished shock absorber, they are already under compression. Accordingly those for the front absorbers should be 6" and those for the rear springs 7" long. The inside diameter of the springs should be not less than 1¼" in any case.

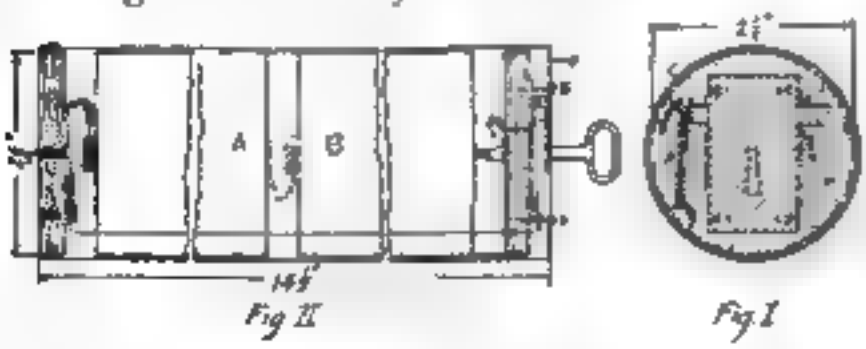
Those fortunate enough to have access to a machine shop can wind their own springs if desired, although there will be no great saving as the springs will be made up as ordered by any good spring manufacturer for about twenty-five cents each.

When placing the absorbers on the car they should first have their springs compressed and tied down with wire in order that they will not interfere with placing the bolts through. To compress them, use a cabinet clamp or vise.

The entire cost of the absorbers described was just $3 34 outside of the work.

Key Controls Battery Current

WHERE batteries are placed on bicycles or motorcycles for lighting purposes, it is a great temptation to mischievous boys to turn the current on, a circumstance which, of course, means a loss of money to the owner of the vehicle. Such happenings can be averted if a lock switch is employed for controlling the battery current.



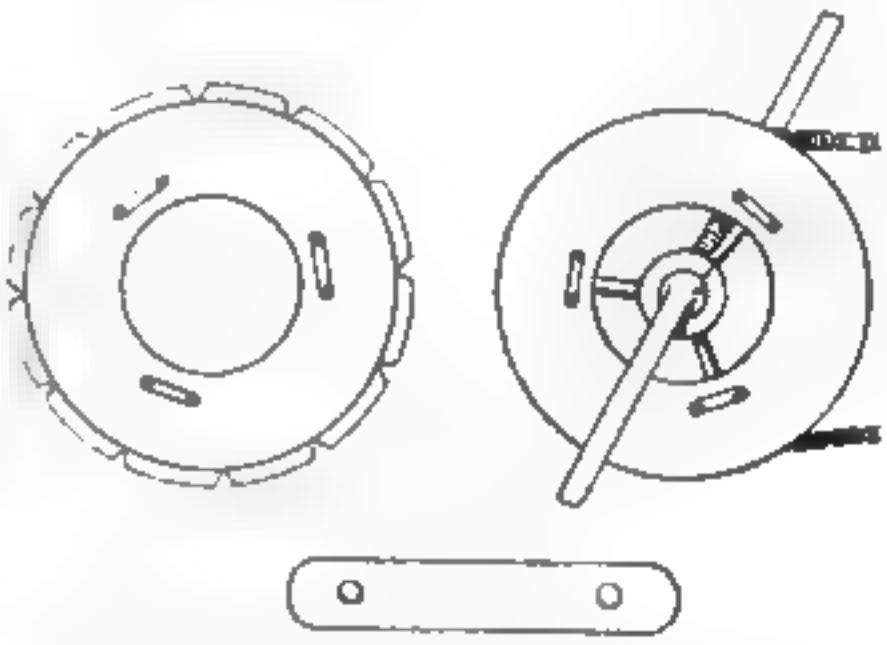
When the key is withdrawn, the auto thief or mischievous boy is foiled

The batteries should be placed in a metal cylinder, the ends of which are plugged with wooden discs. On one of these discs a small drawer lock is fastened. At one side of the lock—the side from which the bolt emerges when the key is turned—a brass or phosphor-bronze contact spring should be fastened.. When the key is turned, the bolt pushes this spring against a brass contact, and current flows from the batteries to the lamps.

Eliminates Pants' Guards for Bicycle Riders

A CHAIN guard can be made for bicycles which will dispense with the need of pants guards.

A circular piece of stiff metal, having a diameter 1" greater than that of the



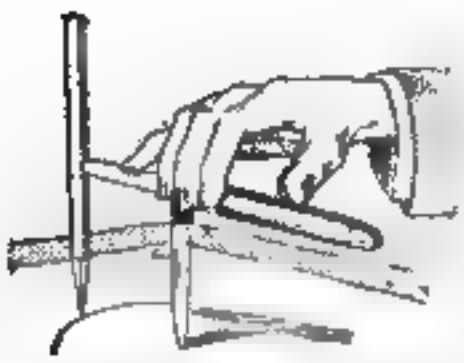
A circular piece of metal protects the trousers from the sprocket gear

large sprocket, should be cut and crimped along the edge. Clamps should be fashioned from heavy steel or iron for the purpose of grasping the spokes of the sprocket. The clamps should be soldered to one face of the protecting disc and holes bored through the two. Machine screws pass through the holes, terminating in tapped holes in similar clamps on the opposite side.

A Try-Square Aid

WHEN using a try-square to determine if stock is true, one cannot remember all the high and low spots. If the edge of the try-square is dipped in lamp black before using, and is then run on the piece, all the high spots will be black while the low places will remain untouched.

How a Jack Knife Can be Used as a Compass



A POCKET knife that has two blades at one end can be converted, with the use of a pencil, into a makeshift drawing compass. One blade should be opened entirely; the other only half way, so that they form a right angle. The blade that is half opened is placed point down on the paper, while a pencil is fastened to the other, and the circle drawn

Enlarging Without Dividers

DRAW a straight line on a strip of celluloid or tracing cloth, and with a thumb tack fix the strip on coordinate paper in such a way that the line always intersects axis XX, YY. This, of course, is best done on a drawing board. By swinging the free end of the strip to any position between the axes, any proportion is obtainable.

The principle of triangles, by which the proportions are obtained, is so well known that further explanation seems unnecessary. Still, here is a concrete example:

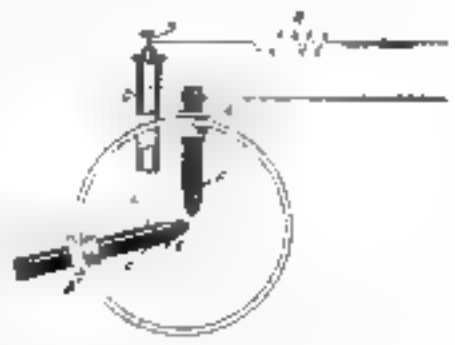
Let us suppose that we want to make a drawing twice the dimensions of an original. Measure a distance of 2″ along the horizontal as indicated and locate the point *P*. Then shift the strip until the vertical distance to the central line is exactly 1″. We then have the ratio 2 to 1 as desired. Every horizontal distance from the axis of the strip is twice the vertical distance.

Should the desired ratio be 4 to 1 or 3 to 1, or anything else, the same method is easily and consistently followed.

Bending Brass Tubes Without Kinking

BRASS tubes can be bent without kinking if they are previously filled with fine sand. Both ends of the tube should be closed with wooden plugs.

A Self-Lighting Arc Light



PROCURE a tin can about 6″ in diameter and cut three holes in the side about 3″ from the back, as shown in the drawing The two holes *AA* must hold a section of rubber hose tightly. A short porcelain tube *Q* is put in the third hole. The hose holds the carbon *F* stiff while the carbon *F* is loose in the insulation. The carbon is supported at *X* by a piece of No. 25 gage German silver wire about 6″ long. This wire runs through the tube *B* to the binding post *D*. The binding post *D* is fastened to a wooden plug in the end of the tube *Q*. The tube is adjusted so that the end of the carbon *E* touches the end of *F*.

The wires leading to the light circuit are connected with the binding post *D* and the end of the carbon *F*. A resistance, consisting of about 15′ of No. 25 gage German silver wire, is inserted at *R*.

When the current is turned on it expands the wire *C*, pushing the carbon *E* away from *F*, forming an arc. When the current is shut off and the wire cools, the carbons are drawn together ready for relighting

An Ingenious Electric Connector

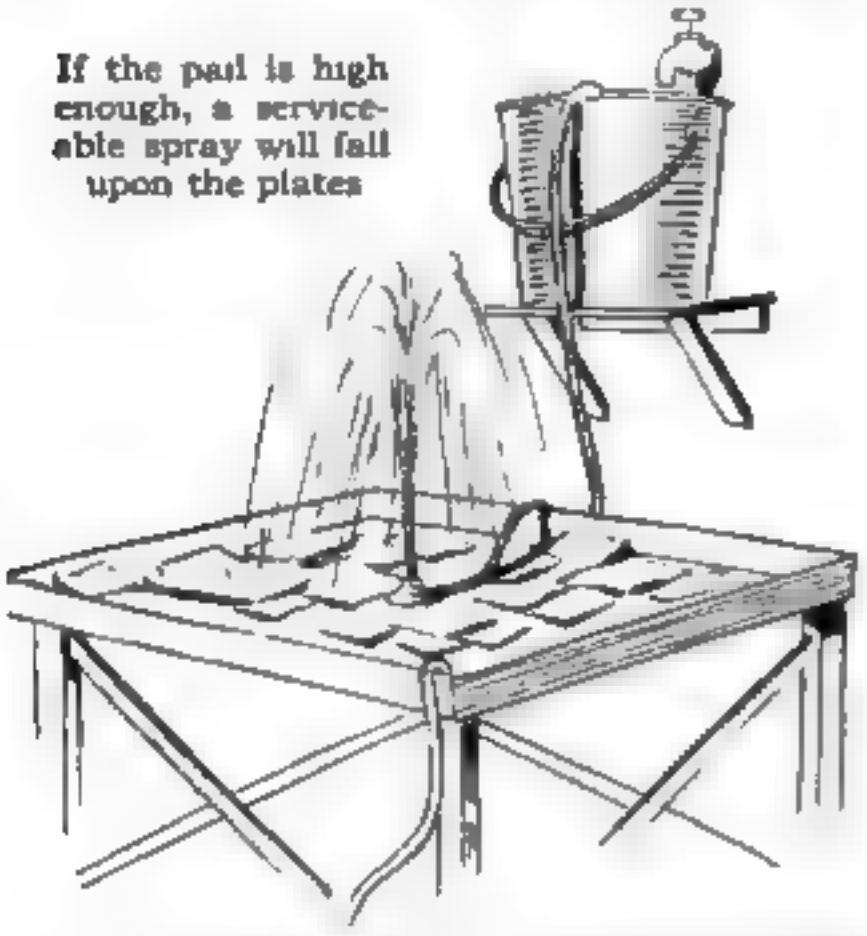
ELECTRIC connectors for low voltage circuits can be made from the small metal cases that are used for storing pen points. Holes should be bored in the ends of each half and binding posts attached, as shown in the sketch. This connector can be used for battery circuits

To Prevent Rust

TOOLS which are kept in a damp cellar can be protected from rust very easily, if a pan containing unslacked lime is placed under the bench. The moisture is entirely absorbed by the lime.

Rinsing Photographic Negatives Without Running Water

AMATEUR photographers who are compelled to labor under the difficulties of developing prints and negatives without the aid of running water,



If the pail is high enough, a serviceable spray will fall upon the plates

will find the apparatus which is shown in the drawings to be of considerable assistance. Water is syphoned through a small tube from a pail, the tube leading to the center of a developing tray where it is bent upwards at a right angle.

If the pail is elevated to a sufficient height above the tray, the pressure will cause a spray, which will be distributed evenly over the emulsion surface. The used water is syphoned from a corner of the tray by another tube

Small Screws in Difficult Places

DAB a bit of beeswax on the head of the screw and push the point of the screw-driver through the wax and into the slot of the screw. The screw will be held in just the right position for driving home. Or again, if the screws are of steel the driver may be magnetized by stroking it a few times with a magnet. Its insertion will then become much easier. If the slot in the head is very shallow, the screw will be likely to slide over and stick to the blade of the screw-driver. In this case, use the bees-wax

Of course, it is evident that the hold on the screw is very light and can be used only to drive a screw into its corresponding tap. For inserting wood screws the above methods are out of the question.

A Mysterious Motor

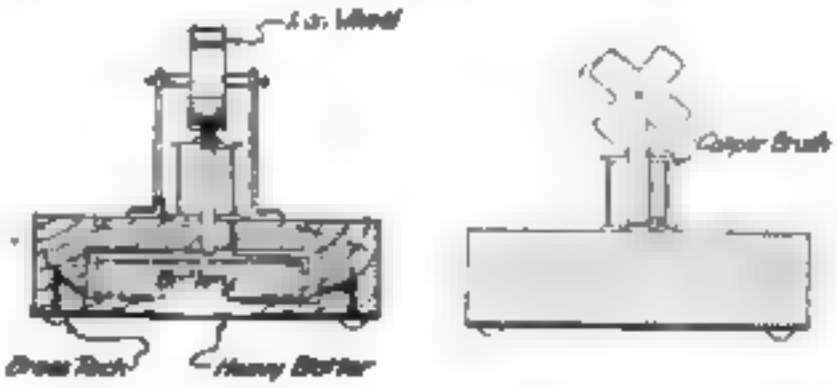
THE "Mysterious Motor" will puzzle any one. Not only the novice, but professional electricians must do a deal of thinking to decide how it runs.

The little toy consists of an electro-magnet over which is suspended a four-spoked iron wheel mounted on a thick wooden base. When placed upon a flat metal surface the motor will run, but when set upon a non-conductor it will remain motionless

The thick base is hollowed out from the bottom to make sufficient room for a small flash-light battery. Four brass tacks are driven into the base. From one of these tacks runs a wire to the thin copper brush, to which the iron wheel acts as a comutator and armature combined. The current passes through the brush into the wheel, thence through the support to the coil. From the coil it passes on to one pole of the battery and from the opposite pole to another tack. This leaves the circuit broken between the two tacks, when the brush is in contact with the iron wheel. Consequently, when the device is placed upon a conductor the circuit is closed and the wheel revolves.

The remainder of the cavity occupied by the battery is plugged with wood, and the base covered with heavy blotting paper, allowing the tacks to protrude.

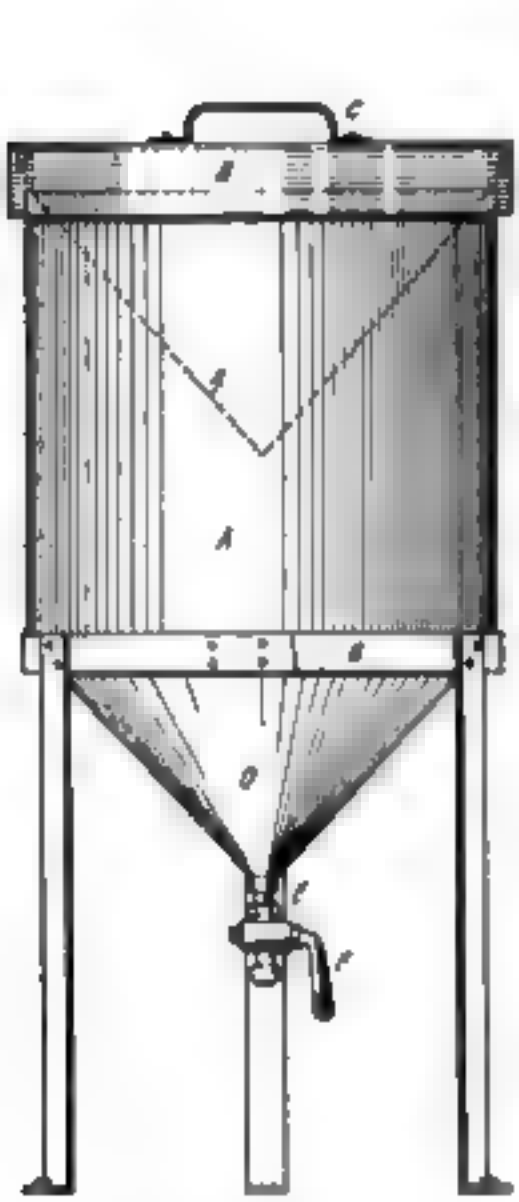
Much amusement may be derived from the "Mysterious Motor," at a party by announcing that you have a motor that will gather its power from the air, when placed upon any metal, and then giving a demonstration.

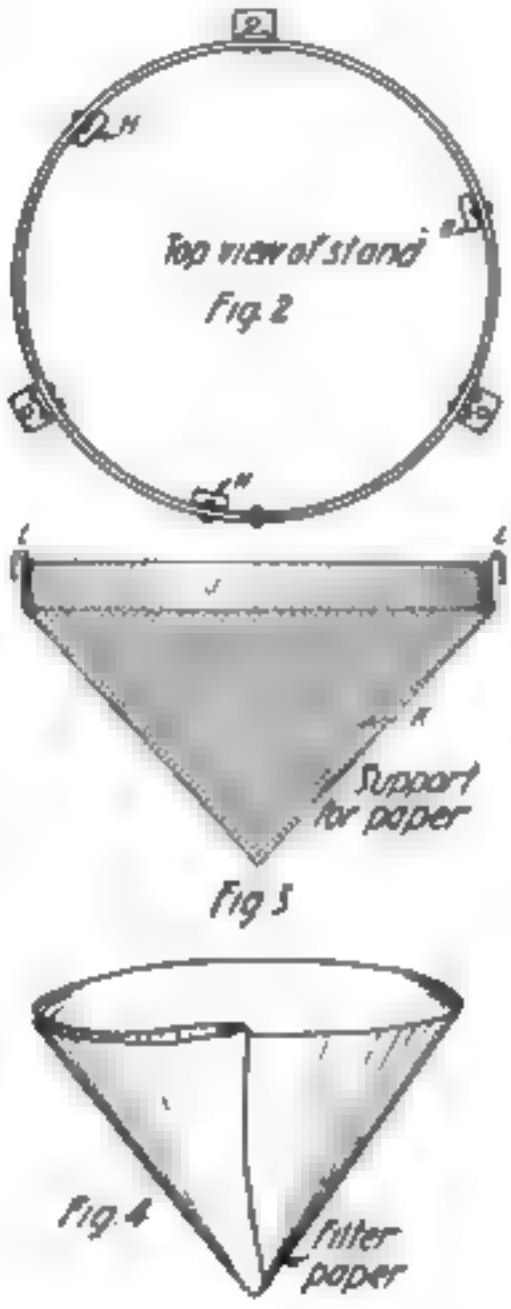


When the motor is placed upon metal it will operate, on wood, it refuses to move

Filter for Lubricating Oil

THE apparatus to be described was made for the purpose of filtering oil pumped from the crankcase of a marine gas engine after it had been used in the cylinders and bearings of the engine. The oil filtered out perfectly clear and was used over and over with perfect success.





The oil is poured into the container through the paper filter, and collects in the container to be drawn when needed

Referring to the drawings, *A* is the container, made of zinc with soldered and riveted seams, about 16″ high and 14″ in diameter. On one end of the cylinder *A* was soldered the cone-shaped part *D* with a ⅜″ brass pipe coupling *E* soldered into the small end. A brass shut-off cock *F* was screwed into this coupling as shown. A loose-fitting cover was made to fit the open end of the container. This cover *B* was about ½″ larger in diameter than the container, and had a handle *C* riveted on to the top.

To support this container a ring of strap iron was riveted together and three legs riveted on, as shown, with holes for holding down screws bored in the feet. Three angle pieces of sheet iron *H H H*, were riveted on to the ring *G* for the bottom of the container to rest on.

Another ring J was riveted together of a size to slip easily into the container. Then a cone was made up of copper wire gauze *K* and soldered to the bottom of the ring *J* as shown. Two or three sheet iron clips *L L*, riveted to *J* and bent over the outside edge of the container, served to hold the cone in place. This wire gauze is intended as a support for the filter paper, which is folded up into a cone as shown in Fig. 4 and placed inside the wire gauze cone. The oil is then poured into the paper and will slowly filter through and collect in the bottom of the container. It can either be drawn off by the valve as needed or be allowed to run through all the time and be collected in a can or other receptacle.

It may require some experimenting to find the best kind of paper to use, but for oil such as "Havoline" or "Monogram" ordinary brown wrapping paper or even newspaper is perfectly satisfactory. Unsized paper is of course preferable, because of its porous character.

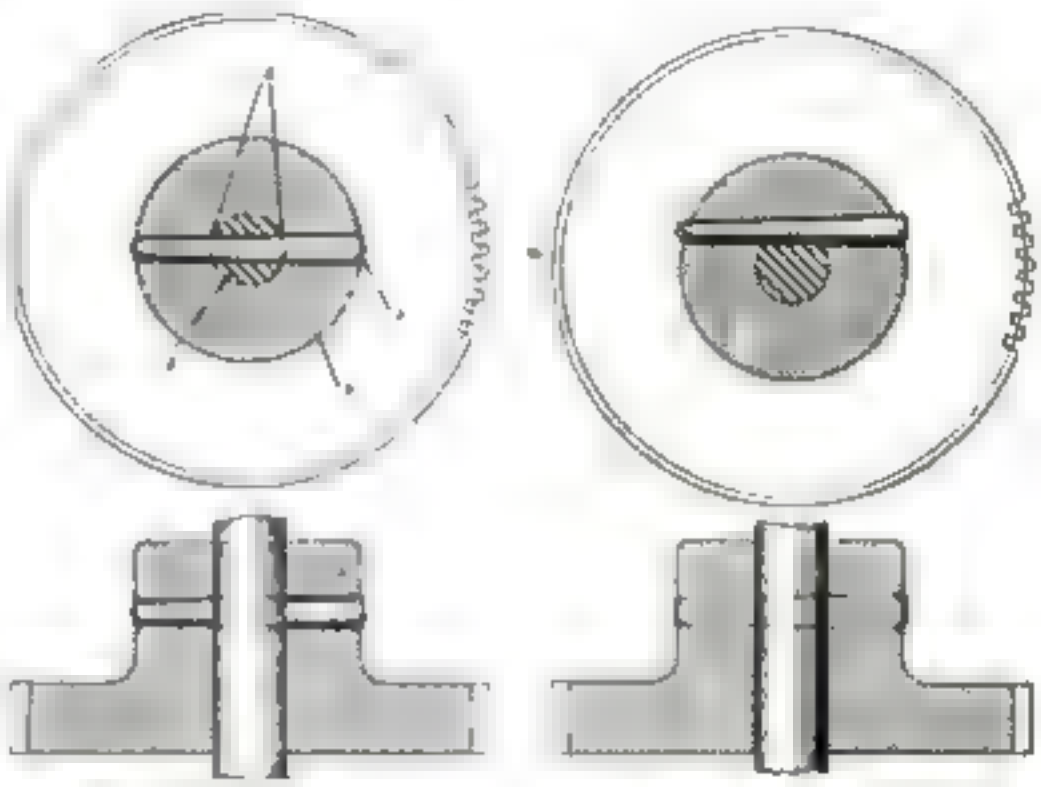
Fuse for Storage Battery Circuits

A PIECE of glass tubing of small diameter is cut into pieces about one inch long. Small holes are drilled in the bottoms of used cartridge shells. The shells should be as nearly the size of the tubes as possible. They are then put on the ends of the tubes and a short length of German silver wire is put through the holes in the shells and soldered. The size of the wire can best be determined by experiment. Two fuses made in this way are fastened to a block of wood by four small clips and the fuse block is done.

A Way of Fastening Machine Parts

IN building models of machines, engines, etc., the amateur is sometimes confronted with a case somewhat like that shown.

The shaft *A* is of small diameter; the hub of the gear *B* is a great deal larger than necessary, requiring a large diameter taperpin *C*. If this pin is driven in as shown in *Fig. 1*, it will weaken the shaft, but if the pin is driven in as shown in *Fig. 2*, the shaft is only weakened slightly. The pin *C* in *Fig. 1* can shear or break or twist at points *D*, but when the pin is driven as shown in *Fig. 2*, this is impossible and the shaft and pin will carry a far greater load than the old conventional way of pinning as shown in *Fig. 1*.

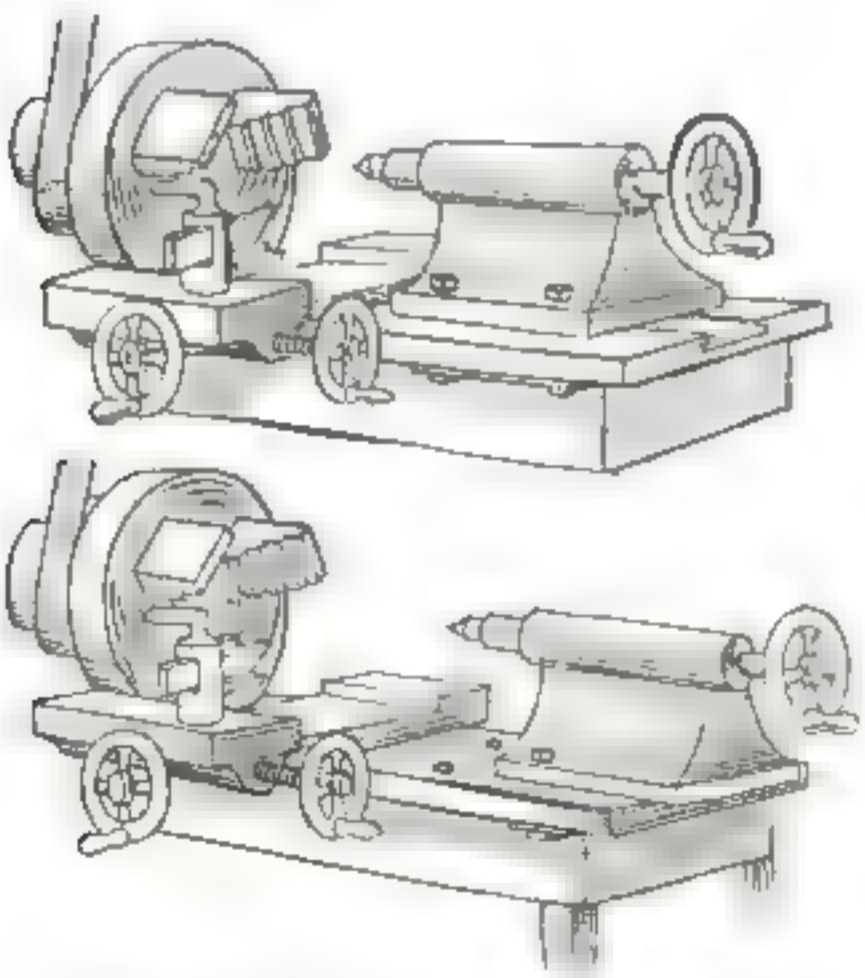


Old method of pinning on the left; new and efficient way on the right

A Capacity Job

SOME small stands had been designed both to length and size at the bottom so that they would fill the lathe completely. When it came to facing the top and bottom of the stands it was discovered that the carriage could not be moved far enough to the right to allow the cross slide on which the tool is mounted to be moved in and out, it lacking only a few inches. The tailstock was fastened down by means of two bolts passing through a wide plate. The bolts were taken out and the plate removed. The plate used for holding the center rest down was used instead. As this plate was only one-half as wide as the regular plate, it was fastened under the left-hand bolt of the tailstock, thus allowing the tailstock to be moved back far enough. The carriage could now be moved to the right, thereby allowing the cross slide to shift in and out.

Before being able to run the carriage close up against the tailstock it was necessary to remove the split nut used in thread cutting, as this nut struck the lead-screw and feed-rod bearings. The drawings show clearly how the gain was made.



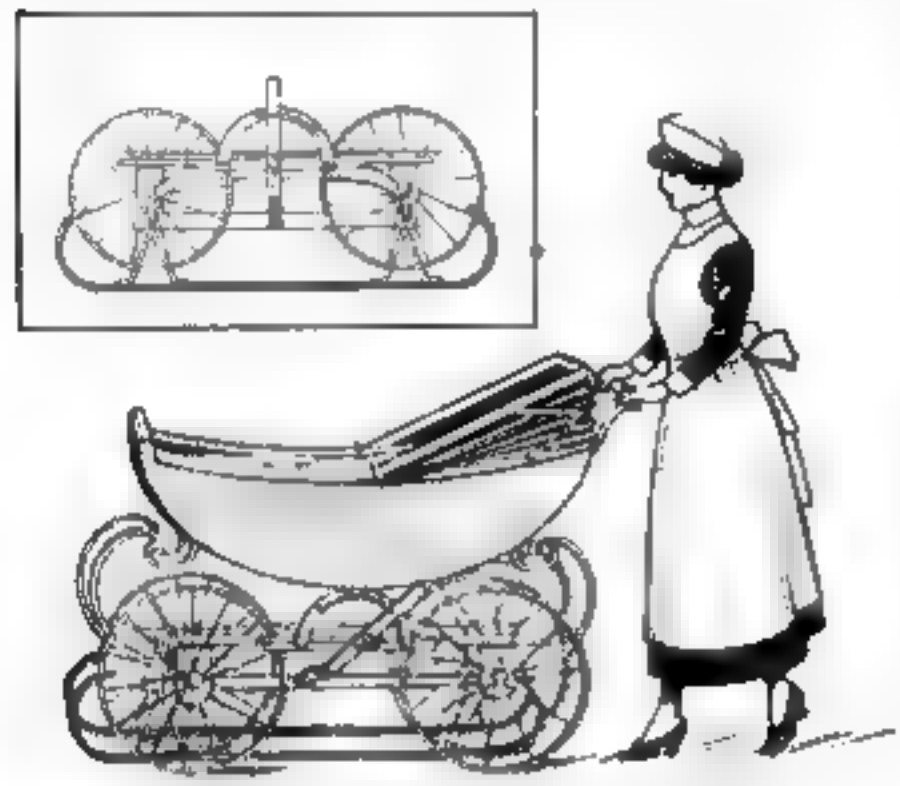
By means of the arrangement shown in the lower cut, the lathe is able to take larger stands. The upper cut is the original arrangement of the lathe

A Good Belt Compound.

A GOOD belt compound is made from equal parts of resin and light machine oil. Boil the mixture for about 20 minutes. Use when cool by pouring a little, drop by drop, on the moving belt. Not only will a good gripping surface be secured, but the compound will also act as a preservative.

Sleigh Attachment for Perambulators

TWO runners are attached to a crank-handle, so that by moving the handle they may be suspended above the level of the wheels or dropped below the

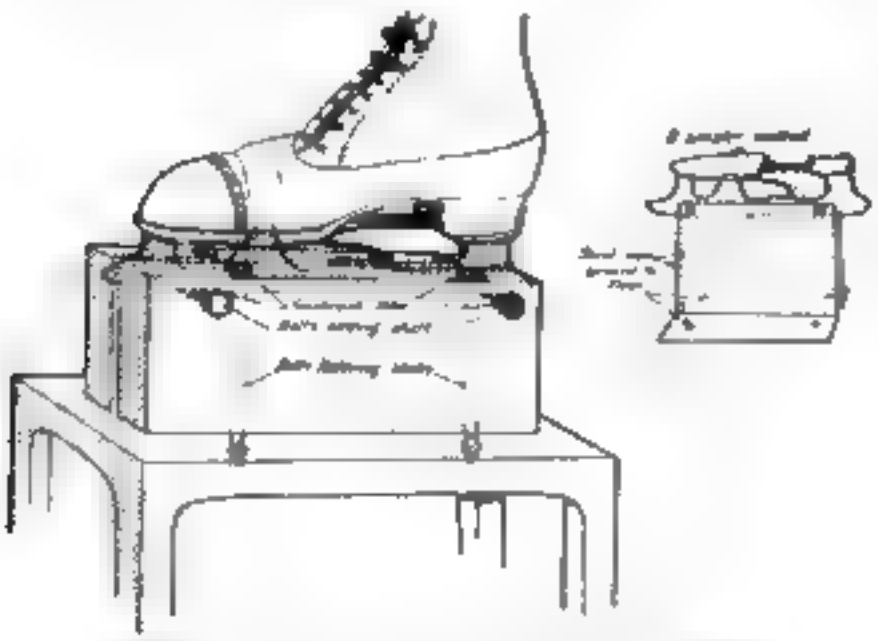


This perambulator may be a sleigh in winter or a carriage in summer

level of the wheels. Thus the perambulator may be used as a sleigh—or as a wheeled vehicle, at the will of the operator.

Ice Skates Make Shoe Shining Stand

DISCARDED ice skates of the type which clamp the soles of the shoe by the turn of a lever can be used for foot rests on shoe shining stands. The steel runner should be bolted between blocks of wood that are nailed or screwed to the foot rest base. With foot rests of this sort, the nervous customer cannot without difficulty, jerk his foot from under the hand or brush of the polisher.

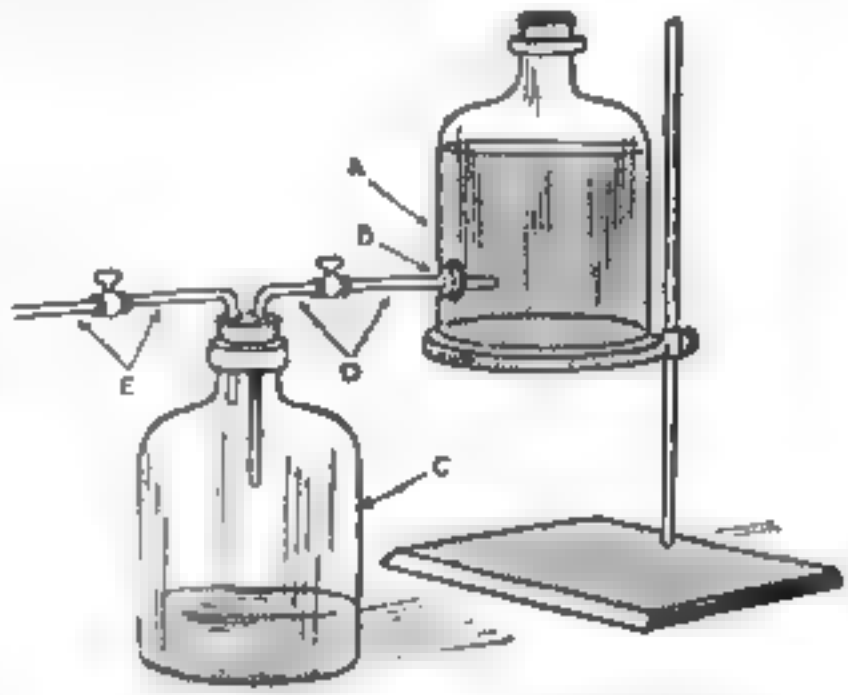


With foot rests made from ice-skates, the customer cannot escape

Substitute for Large, Gas Reservoir

AN apparatus that will take the place of the large and cumbersome reservoirs used in chemical laboratories for storing quantities of gas for experiments can be made with two four-liter bottles and several connecting tubes.

Referring to the drawing, A and C indicate the bottles. A mouth is cut in the side of A and plugged with a rubber cork bored out to accommodate a glass tube. The tube leads from B into the bottle C through a pinch cock inserted at D. Gas is generated from an apparatus leading to tube E and is stored in the lower bottle. When pinch cock D is released the gas is forced out of C through tube E until the supply is exhausted. Water in the upper bottle forces the gas from the lower bottle through the tube E.



This apparatus supplies gas for laboratory experiments

Prevents Insulation Unwinding

THE waxed cotton insulation of annunciator wire can be prevented from unwinding by unravelling a length of both layers and knotting them. As the layers are wrapped in opposite directions the knot will prevent further unravelling or slipping.

Drilling Holes in Glass

THE following mixture on the desired size steel drill, will do a neat smooth hole.

Turpentine .....3 parts
Machine oil .....1 part

Use on point of drill at high speed. This formula is one used by optical grinders.

Hydraulic Blowing Arrangement

THE apparatus here described will be found very useful for supplying air to small blow-pipes in glass-working, etc., also for wood-burning and in jewelers' work, as it leaves both hands free to work. By reversing the valve it may be used for purposes requiring a small suction.

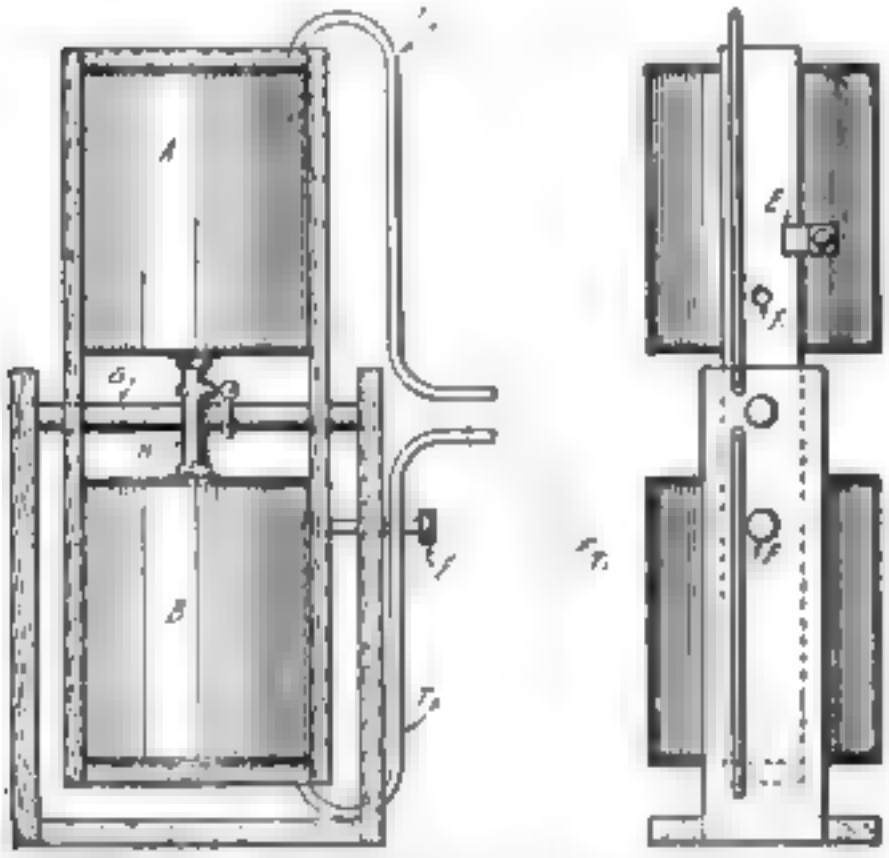


Fig. 1. The hydraulic blower is useful for supplying air to small blow-pipes, as it leaves the hands free

The apparatus is simple and easily constructed. Fig. 1 shows the general plan, where *A* and *B* are cans of the desired capacity (1 gal. being a good size) mounted on the wooden frame work with a pipe containing a faucet, *H*, soldered between them. The cans are fastened to the wood with a metal clip, *E*, which is screwed to the wood and soldered to the cans. The inner framework is mounted on a shaft, *G*, supported by the outer framework, and the cans are kept from turning by the pin, *F*. The tubes, *T*₁ *T*₂, should be made of copper or brass where they extend into the cans and the part outside the cans may be of copper, brass or rubber.

To operate, the top can is filled with water and the rubber tube *T*, which leads to the blow-pipe or other apparatus, is connected to the lower can. The faucet *H* is then opened, permitting the water to flow from the top can into the lower one, thus forcing the air out of the latter, the flow of air being regulated by the flow of water.

When the top can is empty the position of the cans is reversed and the hose is changed to the lower can.

To do away with the changing of the hose, however, a very simple valve, which works automatically with the reversing of the cans, may be used.

The materials needed for the valve are as follows: 1¼″ of ½″ brass tubing, three pieces brass tubing ¾″ long to fit in rubber hose, 1¼″ of brass rod with 8/32″ thread, four 8/32″ nuts, four ⅜″ brass washers, two ½″ leather washers, and two 4/36″ screws.

The ½″ brass tube *T* (Fig. 2) is drilled for the tubes *T1*, *T2* and *T3* and drilled and tapped for the machine screws *S*. The small tubes are then soldered to the large one as shown. The nuts *D* and leather washers *B* and brass washers *C* are placed on the shaft, which is then inserted in *T* after adjustment for right between head distances. The screws *SS* are put in to prevent the moving part from slipping out either end. The valves should be oiled and the corresponding tubes connected. The weight *W* is made of lead just heavy enough to work the valve

The valve is placed on the framework to which the cans are fastened

When the valve is in the position shown the air comes from the lower can through *T3*, through the valve, and out of *T1* to the blow-pipe or other apparatus, while *T2* is open to receive air.

Inverting the weight shifts the valve so that the blow-pipe or other apparatus is always connected with the lower can.

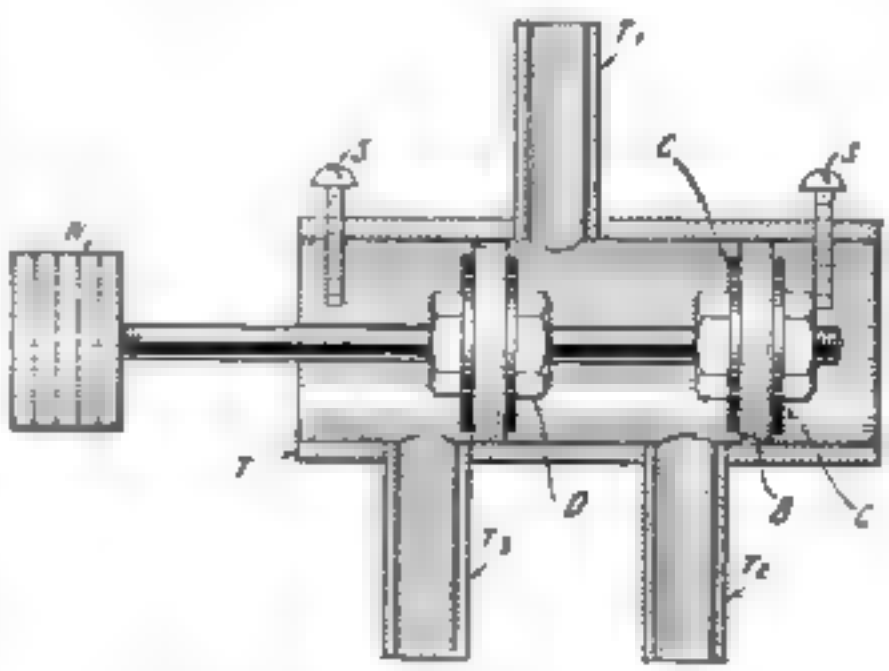
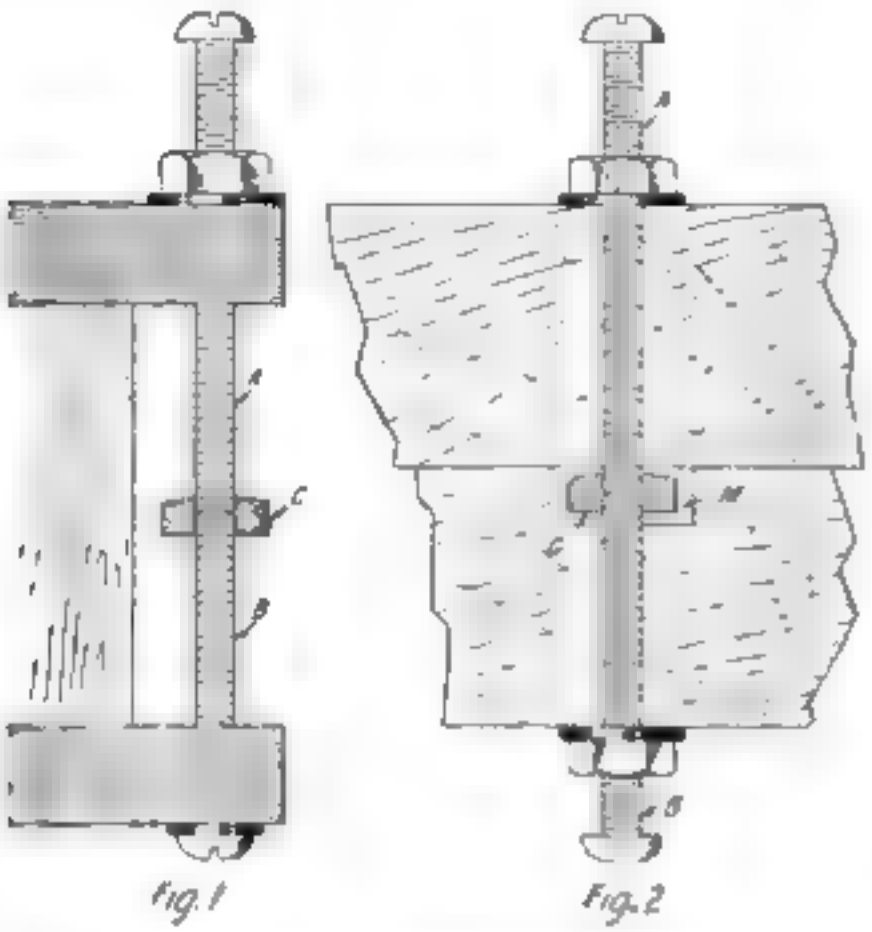


Fig. 2. Showing how the brass tube is tapped for tubes and screws

Emergency Bolts

TWO short bolts may often be made to serve as one long one as shown in Figs. 1 and 2, when no long bolts are at hand. The two bolts *A* and *B* are

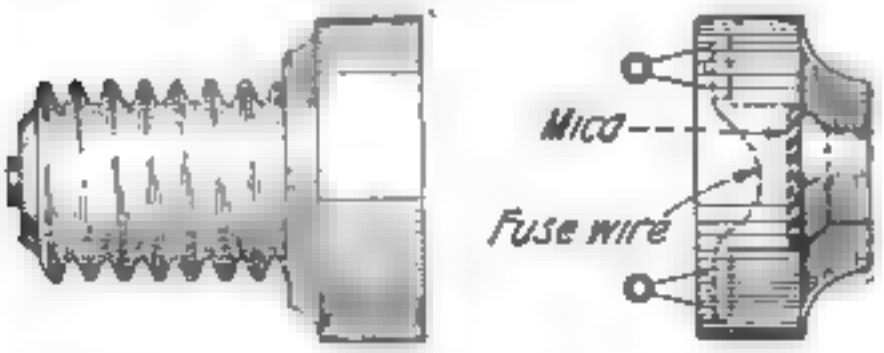


The nuts shown practically double the length of the bolts

coupled together by means of the nut *C*. When two timbers are to be fastened together as shown in Fig. 2, it may be necessary to drill a recess *M* in one of the pieces to hold the coupling nut *C* but often the bolt is used in the manner shown in Fig. 1, where there are two projecting end pieces. In this case it will not be necessary to make room for the nut.

Renewable Fuses

AN attachment plug can be converted into a renewable fuse by removing the flexible cord and connecting a length of fuse wire across the terminals. The plug should be inserted in series with the apparatus.



The attachment plug is converted into a renewable fuse

The Care of Paint Brushes

THOSE who have only occasional use for paint brushes find difficulty in caring for them, as it is expensive to buy new brushes for every job. The following will solve the problem:

Procure a dish (a tin can will do) and fill with water high enough to cover the bristles of the brushes. Then pour in a small quantity of lubricating or machine oil.

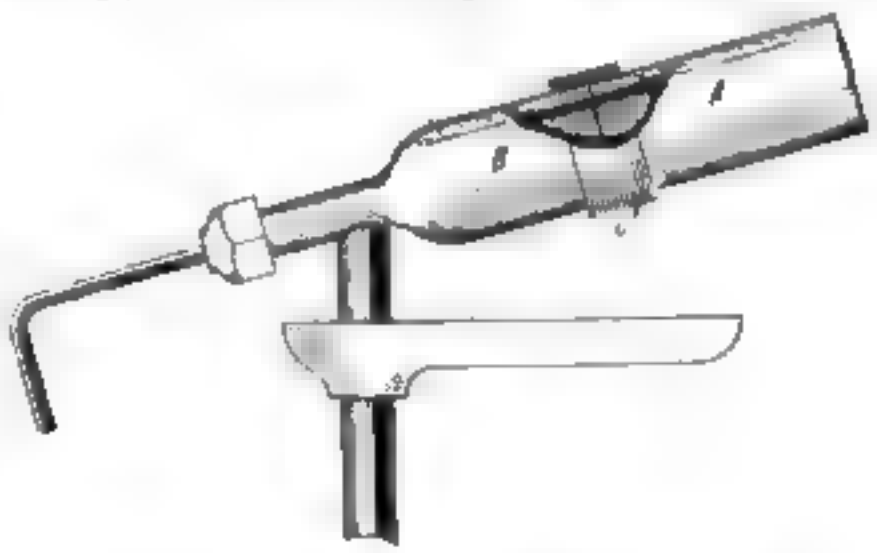
Next wrap the bristles in paper, kept in place with an elastic band or a tied string, and place in the dish of water with the oil floating on top.

The oil prevents the evaporation of the water and the rusting of the iron brush parts.

The paper wrapping keeps the bristles in shape, and prevents contact with the oil.

Lengthens Life of Blow-Torch Burners

WHEN used constantly, the brass tube through which the flame of a blow torch passes is rapidly burned away, so that complete new burners



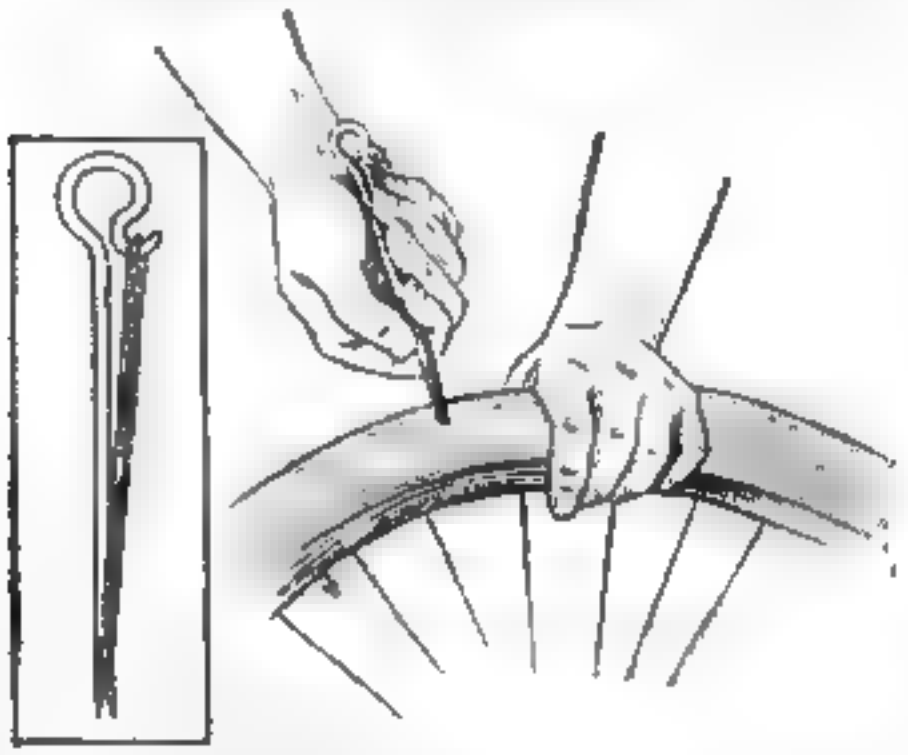
Money is saved when the burner of the blow torch is made detachable

must be frequently attached. This rather costly procedure can be avoided if the actual "business end" of the burner is made detachable, or renewable.

Several short lengths of brass pipe, equaling in size that of the burner itself, should be procured. With a hacksaw cut off an inch or so from the end of the burner and thread the remaining end. A narrow ferrule, or coupling, should be tapped to fit the threads, and the brass tips threaded to correspond with the shortened burner. When one tip is burned down, it can be quickly replaced by a new one.

A Handy Way to Repair a Tire

A VERY convenient instrument which may be used to repair punctured tires can be made from a common button hook. Straighten or cut off the hook part with a pair of pliers. Saw a slit about ⅛ inch from the end up the stem of the hook with a hack saw and round off the ends into a fairly sharp point. With a knife cut all the sharp edges from the slit so it will not tear the rubber bands. Make a hook as shown in drawing, and passing the rubber band first through the slit and then over the hook enough times to fill up the hole in the tire, dip the rubber and hook in tire cement and push through hole. Unhook the rubber band and draw out the hook carefully with a twisting motion so as not to remove the rubber band. Cut off the protruding rubber and you will have your puncture repaired in excellent shape.

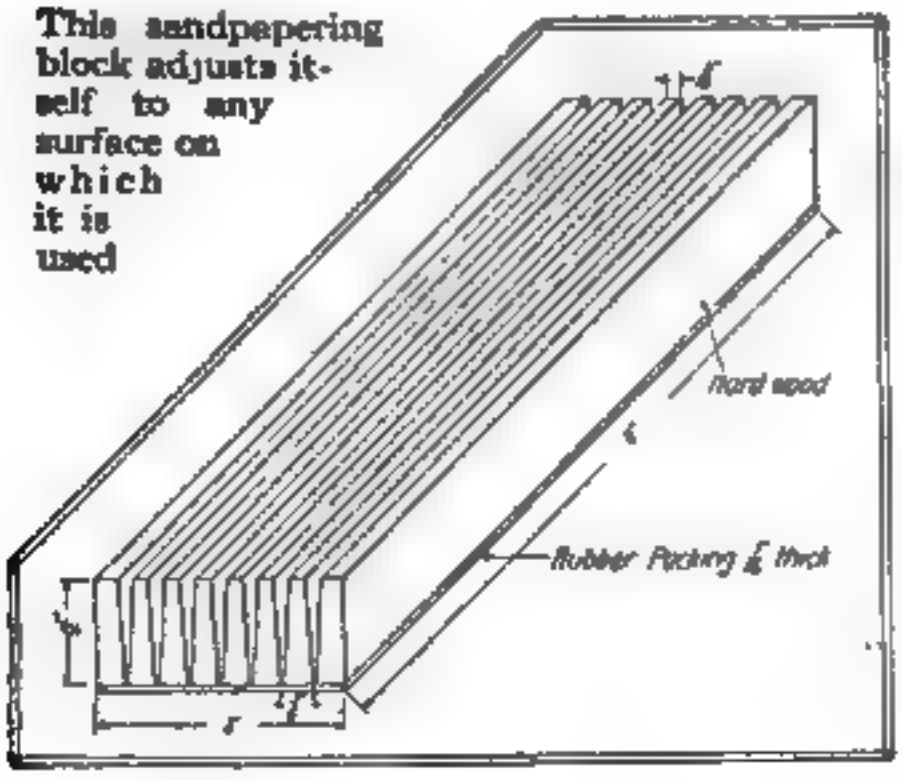


With this tool rubber bands can be pushed into a puncture, to make an excellent quick repair

A Self-Adjusting Sandpaper Block

A SANDPAPERING block that automatically adjusts itself to both convex and concave surfaces of any radius is very easily constructed by using a piece of rubber packing for the face and glueing to the back or fabric side wedge-shaped strips of hard wood of the general dimensions shown in the drawing. These strips should be about 1-32 inch apart where they fasten to the rubber, so that the face will bend easily.

The sandpaper is folded over the block in the usual way and with very slight pressure the face will conform to the surface to which it is applied.



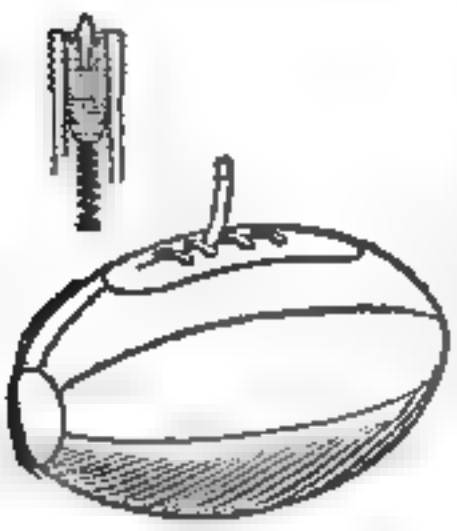
This sandpapering block adjusts itself to any surface on which it is used

A New Use for Broken Drills and End Mills

BROKEN drills and end mills should not be thrown away, as they will be found useful if a special socket is to be made for the lathe or miller, when a drill or end mill is to be held.

By grinding the tang off, it can be turned around in the socket to ascertain if the taper has a bearing the whole length. If a drill or end mill is used without thus changing it, the tang will prevent its being turned around.

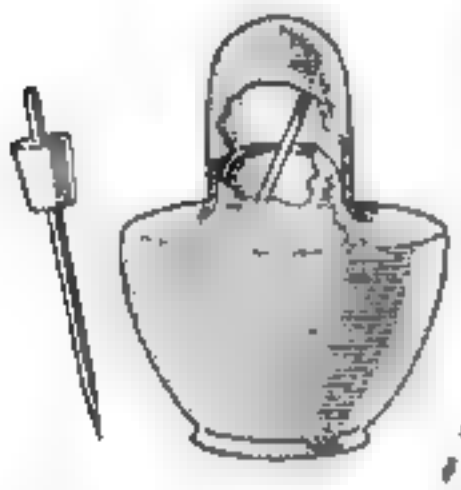
A Home-Made Football Inflater



A VALVE from an old bicycle tire or an inner tube is a very serviceable substitute for the expensive and delicate pumps used to inflate footballs. Cut the metal ring and the rubbed pad from around the valve, and the inflater is ready for use.

Insert it into the neck of the football, attach the outer end of the valve to a bicycle pump, and your football may be quickly inflated.

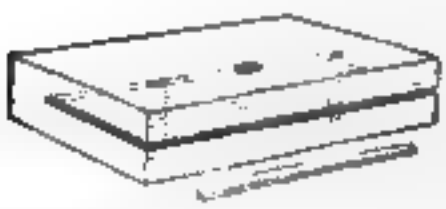
A Dust-Proof Bottle for Acid



A GLASS spirit lamp makes an excellent bottle for keeping small quantities of nitric acid, soldering spirit or other acid liquids. A glass rod may be left in the lamp and covered with the ground cap as shown in the illustration. The cap usually makes a very good fit, and for many purposes no other stopper is required.

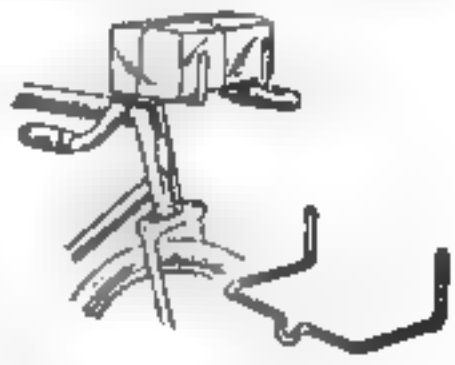
When used to contain nitric acid, for testing gold, however, the other device shown may be adopted. A piece of glass rod is drawn out to a rather fine point at one end and passed through a perforated India rubber cork, which forms an air-tight stopper.

A Multiple Punch



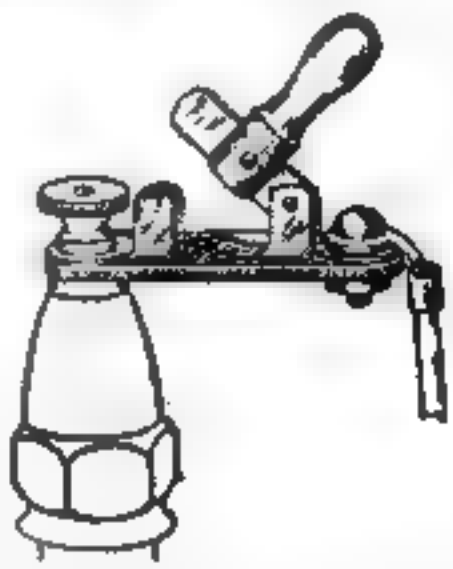
A PUNCH for making a number of holes in sheet fibre or metal can be made from a block of steel machined as shown in the accompanying drawing A punch of this type is intended for work that must be repeated with uniform results.

Parcel-Carrying Rack for Bicycle



THE accompanying line drawings show a simple package-carrying attachment for a bicycle, which can be cheaply and easily made and removed or attached simply. The drawings show clearly the method of bending and the dimensions. Make the pocket to suit the handle bar of the bicycle.

Switch Detects Bad Ignition



IT is often a tedious and troublesome matter to determine which cylinder of a multiplex cylinder engine is missing explosions. A very simple little instrument, shown in the accompanying sketch, renders the discovery of the missing cylinder easy. It is simply a switch, to be fastened to the spark plugs in succession.

RADIO SECTION

Devoted to the Encouragement of Amateurs
and Experimenters in the Field of
Radio Communication

Aeroplanes, Wireless and the War

By William Dubulier

The author of this article is an American radio engineer, who has performed experimental work for the United States Government and whose investigations for the British and Russian governments have attracted attention abroad. His wireless apparatus is now used on British military aeroplanes. His article may therefore be considered as an exposition of the subject of radio communication from aeroplanes from first hand knowledge.—Editor.

THE art of warfare has been transformed by wireless and wireless has in turn been transformed by modern warfare. We can safely say that the one great electrical event of the war is the use of wireless even between trenches, and the directing of artillery fire. While the regular telephone and telegraph are also used, the wires are so frequently broken by shrapnel and shell fire that wireless proves to be the only uniform and trustworthy means of communication. The men themselves at night (the only time when they dare leave the trenches) stumble over regular telephone and telegraph wires and break them, and often there is no opportunity to repair the damage. Not only have the Allies tried to get wireless trench sets, but the Austrians, Germans and other powers as well. The trench set in question is one in which one man and certainly no more than two men are needed to carry, set up and operate. The transmitting distance need not be more than five miles Such instruments are now being built and supplied One type weighs only eight pounds.

For aeroplane use, the instruments must have a greater range. They vary in power from twenty watts to two kilowatts, which latter is the power of the instruments now being installed on big aeroplanes made in England and employed not only to signal the hits and misses of heavy artillery, but also to jam the enemy's stations.

In a wireless installation of this aeroplane type, light weight and compactness are the most important requisites. Let us begin by describing the small installations which require about twenty watts to operate and which are used almost exclusively by the French army for directing artillery fire. In designing this instrument old principles were revived—principles quite the same as those in vogue when wireless first came into being. There is a small induction coil with a vibrator and a spark gap, and an aerial and ground or counter capacity connected across the secondary. This is shown in Figure 1. The efficiency is greatly increased by connecting the condenser across the interrupter and primary as in the Dubilier system in-

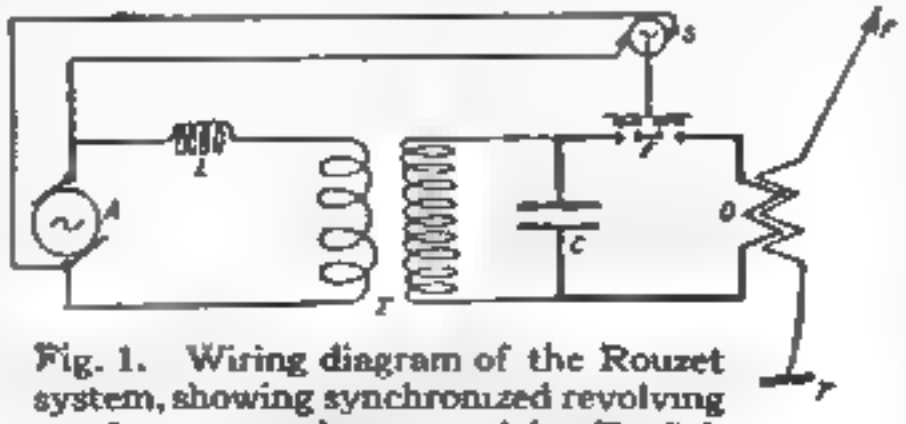


Fig. 1. Wiring diagram of the Rouzet system, showing synchronized revolving spark gap now being used by English and French governments

stead of the condenser across the interrupter, the former custom. The battery is a small case containing ten, eight ampere-hour cells of twenty volts, and the secondary is connected with the discharge electrode or oscillator mounted on top of a small case within which the

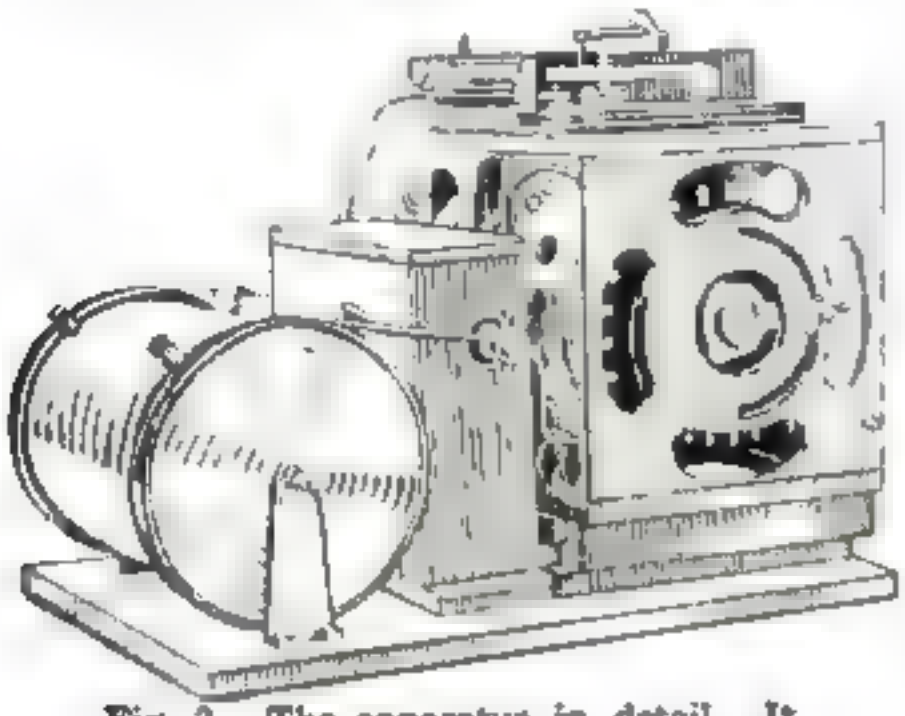


Fig. 2. The apparatus in detail. It weighs, complete, about 30 lbs, for 150 watts, and includes one self-exciting 250 cycle generator with synchronized spark gap, one Dubilier condenser, one transformer in oil, and a loose coupled tuning coil

rest of the apparatus is fastened. The oscillator is mounted outside to take advantage of the rush of air in the aeroplane track along, thus cooling it. The aerial and equivalent capacity is connected directly across the spark gap, thus eliminating the necessity of tuning by means of a condenser and tuning coil. The arrangement is much the same as that which Hertz and Marconi used in their initial experiments. It will be seen, therefore, that the operating circuit produces a natural wave without the necessity of adjustments such as are necessary for most spark transmitters.

The primary input is about twenty volts and one-half an ampere. The interrupter produces a musical note of about 250 frequencies. The trailing wire, which is used as the aerial, is about 150 feet long, and has a three-pound lead weight attached to it. With this small power we were able to obtain five-tenths of an ampere in the aerial wire circuit, the capacity of which was about 0.00003 m f It was found that communication could be effected a distance of fifteen miles. This served the purpose very well, especially for directing artillery fire. The receiving wireless station was situated about one mile behind the guns. Between the receiving station and the gunners a regular telephone line was set up.

The position of the aviator is obviously very perilous. He must be right over the enemy's trenches if he is to direct every shot of the artillery. When a shot falls short or long or too much to the right or to the left, he flashes the information at once to his station. The next shot follows the course that he indicates. This is the most effective electrical work which has been done in the war.

The aeroplane employed in this dangerous service is a two-seater containing a pilot and the observer. The observer sends his messages as quickly as he makes his observations.

Another set of instruments is used, of 150 watts capacity, the energy being obtained from a generator driven by the engine of the aeroplane. Various installations are used of this capacity, some utilizing direct current and some

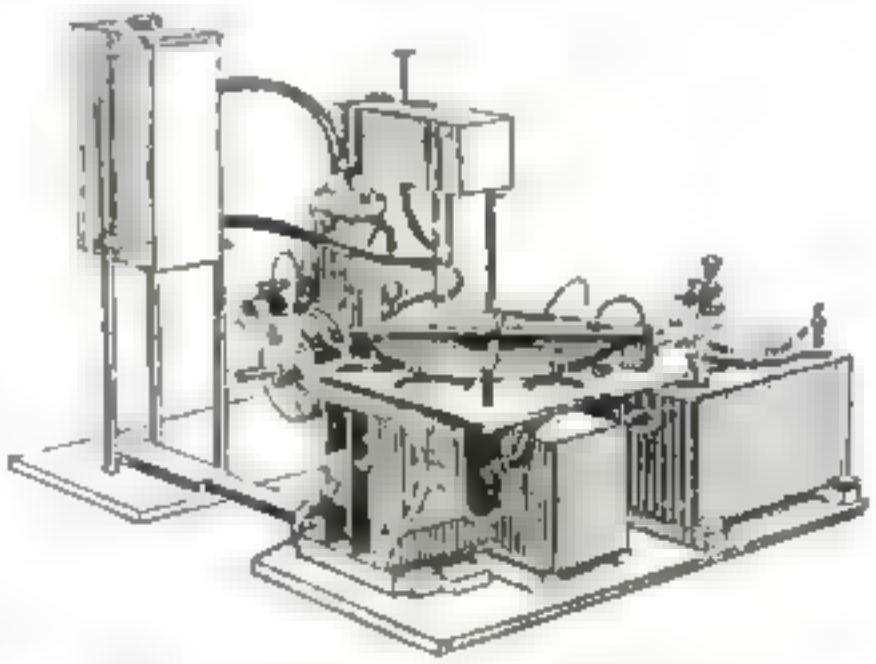


Fig. 3. The apparatus with a small engine for portable use

alternating current. The best instrument in my opinion is one which has a 250 cycle alternator attached by a belt to the gas engine. This generator is of remarkably light weight and is so constructed that it is self-exciting. The whole installation, including the generator, a closed core transformer in oil, a key, condensers, loose-coupled tuning coils and hot wire meter weighs complete but 27 pounds. How remarkable is this installation may be gathered from the fact that the ordinary machine

weighs between 75 and 100 pounds. An installation which I have been supplying the United States Government for aeroplane work, weighs 60 pounds. Yet here we have a complete apparatus weighing but 27 pounds.

It would be practically impossible for one to build such a set in this country for government use because the government tests would automatically eliminate the instrument itself. For example, the generator if run under ordinary conditions in a room would not stand up under fifteen minutes' continuous use. The United States Government insists on a test of eight hours' duration in a closed room. The French and English have wisely concluded that since the generators are used in an aeroplane travelling through air at the rate of sixty miles an hour, a cooling effect is obtained which may be utilized and which will simplify the task of the radio designer. This generator seems to work most satisfactorily and ought, it appears, to be employed by our own navy for aeroplane work. On one end of the shaft of the motor is attached a rotary synchronized spark gap. A small closed-core transformer mounted in a fibre tank full of oil and generating about 20,000 volts is included in the secondary. The condenser used is of the Dubilier type. This is the standard for aeroplane installations in Europe for the Allies.

The condenser is the most important element of the aeroplane wireless installation; for it is obviously impossible to use fragile Leyden jars. The condenser must be unbreakable, have high efficiency, and occupy very little space. Figure 2 shows such an installation.

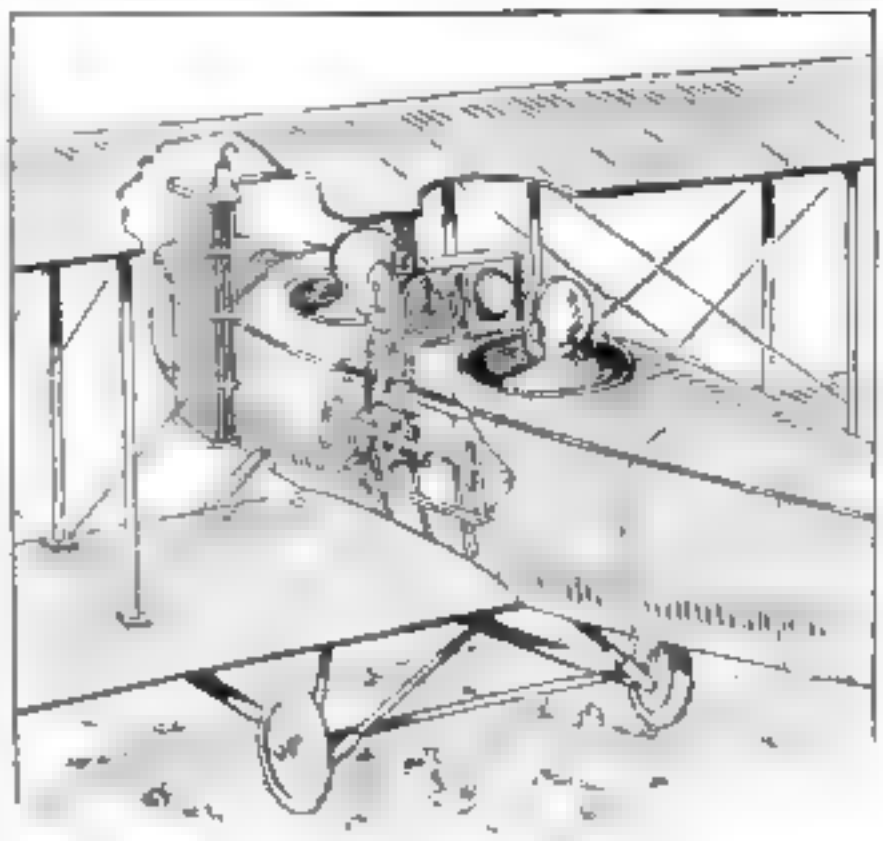


Fig. 5. A 750 watt equipment on aeroplane using the resonance alternator of J. Bethenod. This alternator generates an alternating current of 1500 cycles, 750 watts, at a speed of 4500 R.P.M. The outfit consists of a generator, a transformer, oscillating circuit and a system of manipulation. The generator complete weighs but 42 lbs., and is built for an overload of 20%. It is driven by the motor of the aeroplane. The transformer has a closed core, and is air cooled without magnetic leakage. The oscillating circuit provides for operating on a wave length up to 600 m., and is self-excited by a condenser with 0.01 M. F. capacity

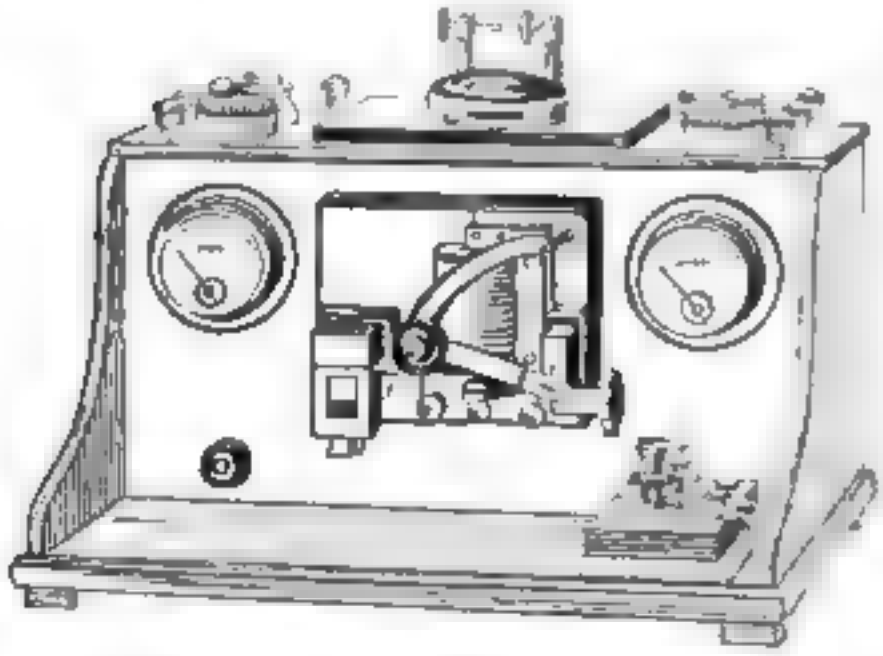


Fig. 4. The small apparatus used mainly by the French for directing artillery over trenches. This apparatus weighs about 12 lbs. and is capable of utilizing about 40 watts

By means of a small aeroplane aerial it is possible to radiate one ampere with this installation. Communication can be held over distances of fifty miles. The English government is building its own installations along these lines.

Duplex Wireless Telegraphy.

DUPLEX wireless telegraphy, in which two messages are simultaneously sent in opposite directions between two radio stations, is entirely practical. The system is used between Glace Bay and Clifden, and in the trans-Pacific stations. This arrangement makes it possible to handle twice as many radio messages between two stations in a given time.

Recent Radio Inventions

New Patents on Wireless Instruments

By A. F. Jackson

AMONG the most interesting patents of 1915 is No. 1139226, issued to E. Raymond-Barker, for a system of radio-telegraphy using two wave-lengths for transmission of a single message. Instead of sending Morse signals in which the dots and dashes are distinguished by the difference in duration of impulses, this method uses signals all of the same impulse length but distinguishes between dots and dashes by sending each at a different wave frequency. That is to say, only short signals which correspond in length to ordinary Morse dots are sent, but these are emitted at two different wave lengths, one of which is for dots and one for dashes.

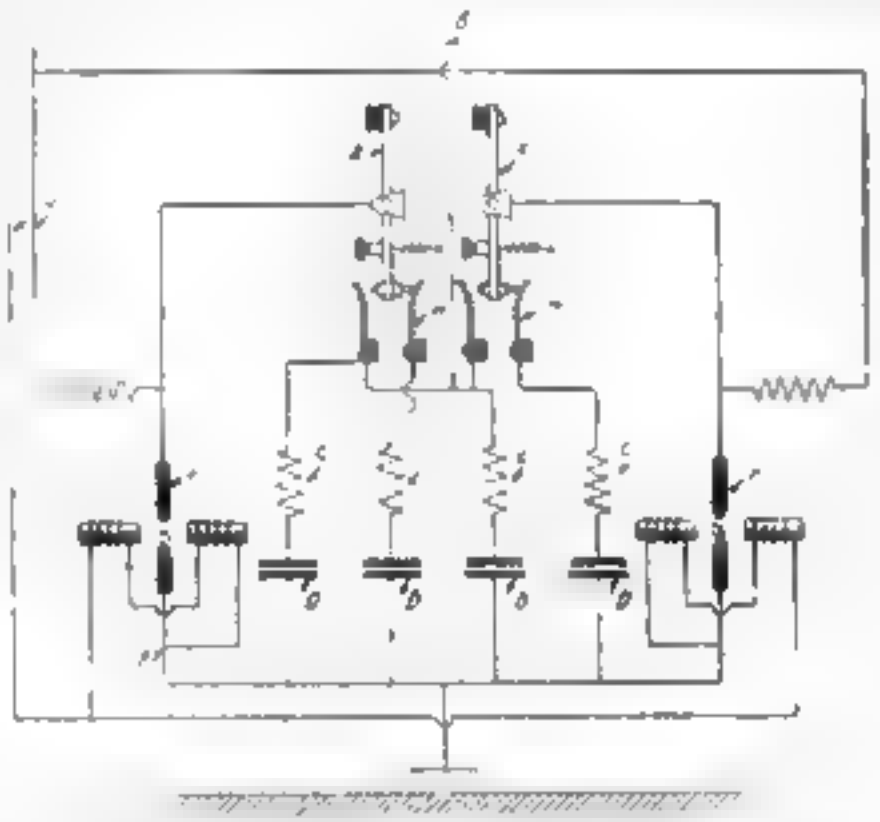


Fig. 1. Raymond-Barker double-wave transmitter

Figure 1 shows the way in which the invention may be applied to a Poulsen transmitter. Here the power lines *G* supply energy to two oscillating arcs, *F F*, through suitable impedances. The central contacts or levers of two telegraph keys *A* and *A1* are connected in the shunt oscillating circuits of the two arcs, and serve to connect the arcs either to radiating resonant circuits *C D* or to non-radiating resonant circuits *C1 D1*. Considering the operation: When neither key is depressed both arcs are connected to their non-radiating circuits through contacts *H H*, and generate in these circuits oscillations of different wave lengths. If it is desired to send a dot the left-hand key is depressed; this connects the left-hand arc to the antenna, and waves of a certain length (say 3,000 meters) are radiated. If a dash is to be sent, the right-hand key is pressed for an instant, and for that time the right-hand arc is connected to the antenna and allowed to radiate waves of its different wave length (say 4,000 meters. Thus combinations of dots and dashes corresponding to the letters of the Morse code are transmitted.

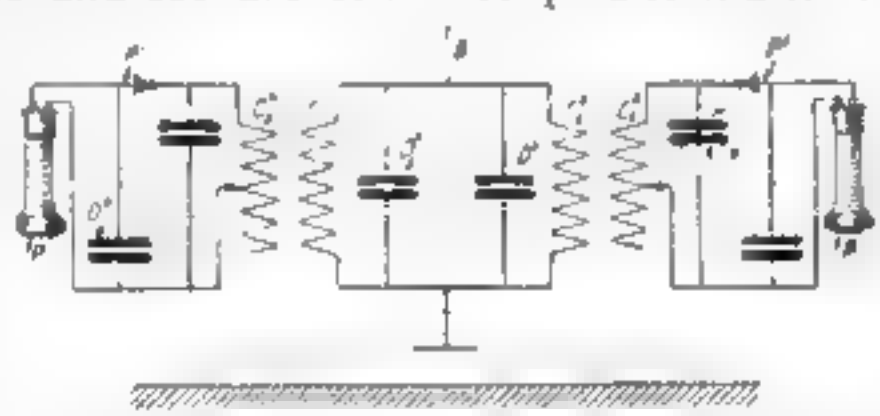


Fig. 2. Telephonic Receiver for double-wave system

At the receiving station it is necessary to pick up signals on either wave length and to indicate that one represents dots and the other dashes. Fig. 2 shows one way in which this may be done: The receiving antenna *B1* is connected to two parallel tuned primary circuits, *C5 D5*, one of which is tuned to the "dot wave" and the other to the "dash wave." Each primary has coupled to it a tuned secondary *C6* which acts upon a tikker detector *P1* with telephone *P* and stopping condenser *D6*. One telephone is held to each ear of the operator and the dots distinguished from the dashes by noting which 'phone gives the response. A simpler way of distinguishing the dots and dashes is by adjusting the tikker-interrupter speeds

and the condensers *D6* so that the sound of the dots is somewhat different from that of the dashes. This gives in effect a two-tone system, and obviously permits higher signaling speeds than does the usual dot-and-dash method. In addition to the increase in speed the two-wave lengths feature offers excellent security from interception of the messages by ordinary radio receiving stations.

When the signals received are sufficiently strong to operate a sensitive relay it is possible by this method to make a siphon recorder pen-and-ink record corresponding exactly to cable "slip." If a relay is connected to each side of the receiving system, the two contacts may be used to control a third polarized relay which will remain in an open neutral position so long as no signals are received, but which, when waves are arriving, will close its local circuit and permit current to flow in one direction or the other according to whether it is operated by a dot-impulse or a dash-impulse. A siphon recorder in this last-named local circuit will record the signals by a wavy line having a hump above its neutral position along a central line for each dot, and a hump below for each dash. Fig. 3 shows the actual connections of apparatus set up to accomplish this result, and in this diagram the action may easily be traced from the sensitive relays *U U*, which are connected to the two detectors, to the siphon recorder *g*

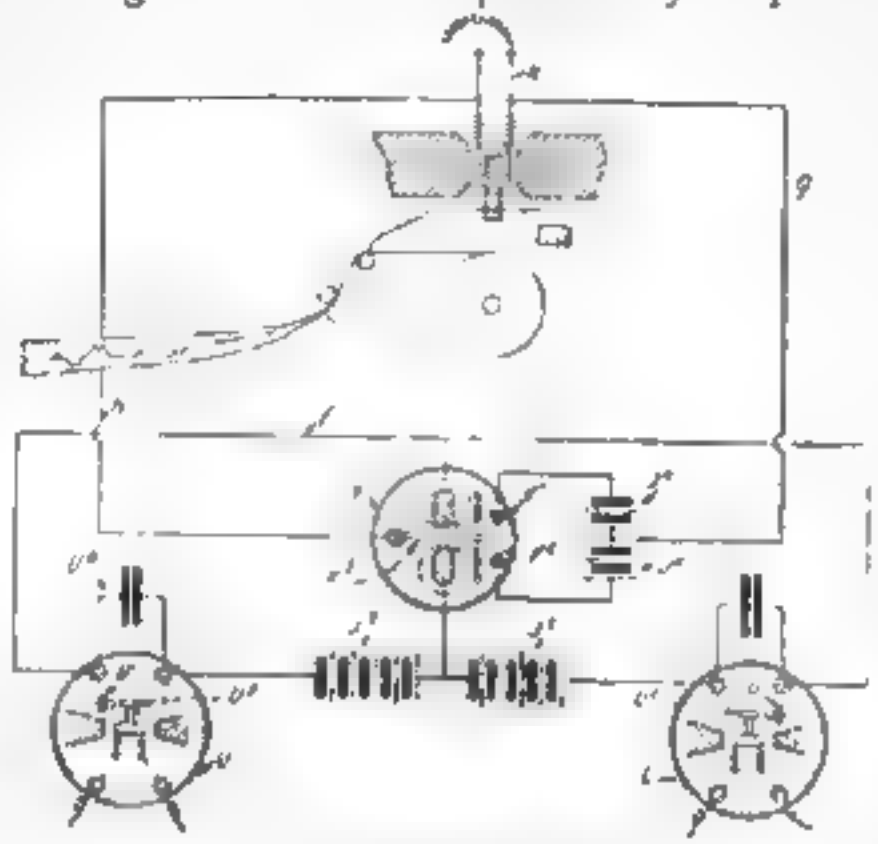


Fig. 3. Relay connections for recorder operation

U. S. Patent No. 1127921, issued to G. W. Pickard, is on an important detail of receiving tuning apparatus. Before the adoption of inductance varying arrangements similar to that shown in this specification it had been customary to rely upon either sliding contacts, variometers or roller inductances for tuning Each of these methods has disadvantages; sliders give poor contact at times, and cause loss of energy through short-circuited turns; variometers are limited in range of adjustment, and have their total resistance in circuit even at minimum inductance; roller arrangements are bulky, and slow in operation. All these difficulties may be overcome by the use of multiple-point switches connected to the turns of the coils, but it would be practically impossible to have a switch-point for each single turn of a long coil. If a saving in the size of the switch is attempted, by making each point cover a number of turns, it is not found possible to get sharp enough tuning unless an auxiliary variable inductance or condenser is used.

The plan of wiring shown in Fig. 4 makes it possible to get single-turn steps of inductance on a long coil by using two small switches. One of these, indicated by *S*, has taps taken off the body of the coil at each tenth turn. The other, *S1*, has its points connected to each of the last ten single turns on the coil. The leads to the coil, *A* and *G*, run to the levers of the two switches; and each terminal may be connected directly to the tenth turn of the coil by placing its respective switch lever on a button marked "O." This *common zero* of the two switches seems to be the novel point in

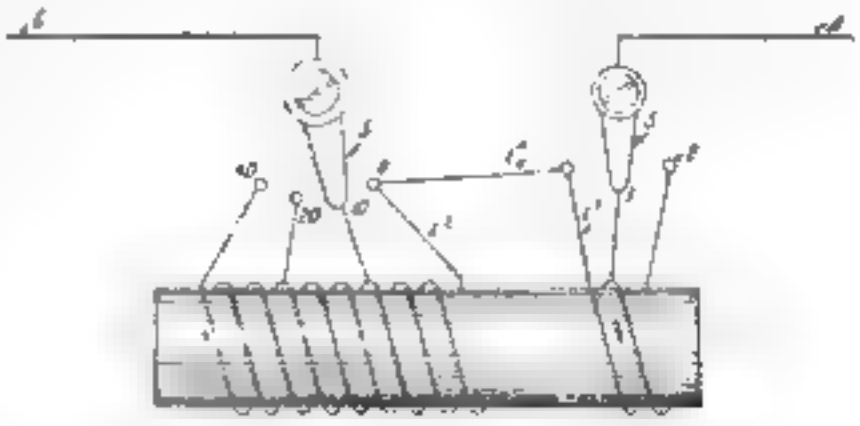


Fig. 4. Common zero switches on inductance coil

the present patent, and is the artifice by which it is possible to adjust to any inductance from zero to full value by steps

of a single turn. Reference to Fig. 4 shows that each step to the left of switch *S* adds in circuit ten turns of the coil, and that these large jumps of inductance may be filled in by the smaller steps secured by moving switch *r* to the right.

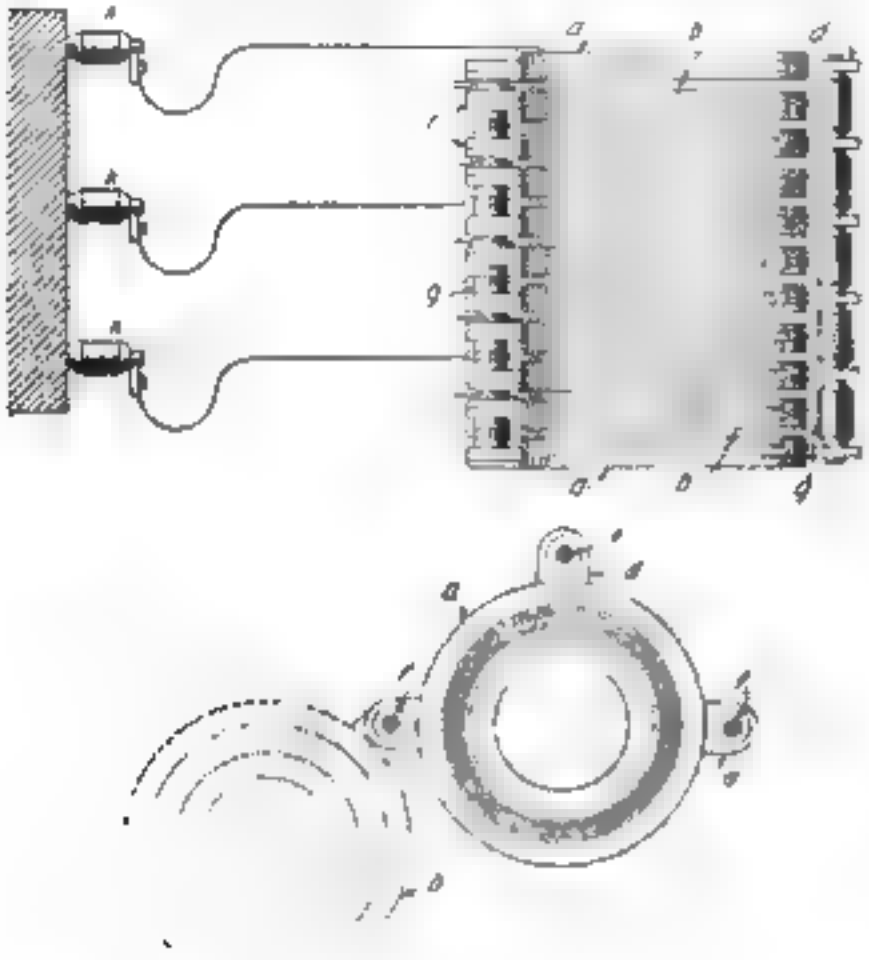


Fig. 5. Arco and Rendahl high power variometer

This switching system has come into wide use within the past few years.

One of the difficult problems of radio engineering is the construction of an easily varied inductance capable of carrying such high currents as are encountered in the oscillation circuits of powerful transmitting stations. Flat spiral coils have proved useful, but if they are to be used for final adjustment some way is needed to change their inductance gradually without interfering with the current through them. 1915 patent No. 1131187, issued to G. von Arco and R. H. Rendahl, shows an interesting way of doing this. Referring to Fig. 5, two sets of flat spiral coils *a* and *b* are seen to be mounted in a framework which permits the group *a* to be moved away from the others by swinging them about the pivots *f* as an axis. The whole set of coils is connected in series, with taps taken off at terminals *k*, and the units are carefully insulated from each other When the moving group is in the position of closest coupling to the fixed coils the system has its maximum inductance, since the magnetic fields of all the coils are co-operating; when, however, the *b* coils are swung out into the position indicated by the dotted lines at the bottom of Fig. 5, the maximum addition of fields no longer occurs and the inductance of the system is very much reduced. The special advantages of this method of mounting arise from the fact that parts having large differences of potential are kept well separated. Although the simple two-coil variometer construction used in receiving coils will give an inductance variation as large as 1 to 15 when insulation difficulties are small, in the two coil form as applied to high-powered transmitter the coils have to be kept so far apart that the maximum inductance is only about twice the minimum. With the sub-divided form shown in this patent, however, heavy currents can be carried and yet a considerable inductance variation attained

Fig. 6 shows an interference preventer arrangement patented in 1915 by T. B. Miller, specification No. 1127368. In the ordinary interference preventer of Fessenden two primary circuits connected to the antenna act on two opposing secondaries; one primary is adjusted to receive the desired signals selectively and to impress them upon the detector, while undesired signals are caused to affect both branches of the circuit equally and oppositely and so produce no final effect. The circuit of Fig. 6 differs from this earlier arrangement in that a single antenna primary circuit is used with two secondaries and two detectors,

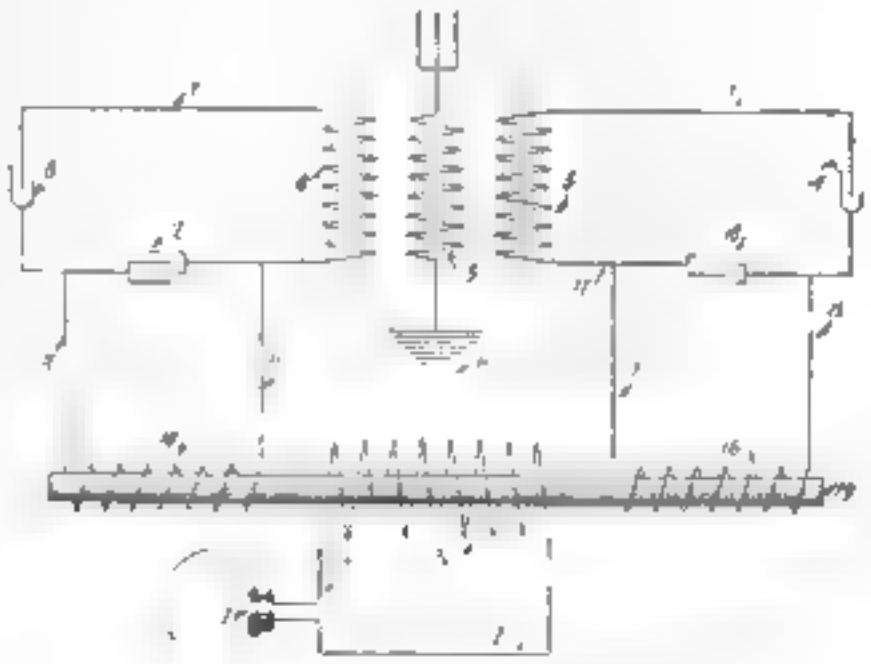


Fig. 6. Interference preventer

and the neutralization of interfering signals is accomplished by opposing their effects in the telephone circuits.

The primary 3 is coupled to secondaries 4 and 5, with their corresponding detectors 8, 14, and stopping condensers 12, 18, in the usual manner. The leads from the condensers 12, 18, which ordinarily go direct to telephone receivers, are in this case carried to the two primary windings of a telephone transformer. These two coils, 10 and 16, oppose each other's effects upon the secondary 20, which has in series with it the telephone receivers 21. This transformer is adjustable, so that either of its primaries may be caused to induce stronger signals in the secondary than will the other.

The operation of the device may be considered in connection with a condition assuming simultaneous sending by two wireless stations, one nearby and the other distant. Suppose that with an ordinary receiver the strong signals from the nearer station practically drown out those coming from a distance, and yet that it is desired to read messages on the weaker waves. With the apparatus of this patent the receiving operator would adjust one of the detectors, say 8, to a sensitive condition in which it would respond well to the weak signals. The other detector, 14, is then adjusted to receive only the strong signals. Thus there are set up telephone currents in primary 10 from both stations, that from the distant one being much weaker than that from the interfering set, and telephone currents in the opposite direction in coil 16, these latter being only from the interfering station. Since the sensitiveness of detector 14 has been reduced, the interference currents in 16 will be weaker than those in 10. By loosening the coupling between 10 and 20, the signals from the interfering station will oppose in their magnetic effects on the secondary, and so produce no response; if it has not been necessary to weaken the coupling too far, the signals from the distant station should still be heard

Thus, if detector 14 is of the type which requires a certain fairly large current before it gives any response, and if the difference in signal intensities is not too great, some very advantageous interference reducing effects may be had.

A Cheap Ground Clamp

A hose clamp can be purchased at any hardware store at two for five cents and a binding post taken from the zinc side of an old dry battery. A hole is then drilled in the hose clamp and the post soldered fast.

Insulators can be made by taking a broomstick, sawed into 4 inch or 5 inch lengths and having a screw eye put in each end. Baked and thereafter boiled in paraffine these make first-class strain insulators. To prevent splitting, a hole should be drilled in each end a trifle smaller than the screw eye and then filled with glue. The screw eye should have a coarse thread. The tough hardwood holds the eyes so they will stand a heavy strain. Two coats of black asphaltum make them resemble hard rubber.

Strain insulator made from a broom stick

Crystal Detector Hints

WHEN the best results are to be obtained, the crystal should be mounted in a fusible alloy. This can be easily made by melting equal parts of ordinary fuse wire and tinfoil and adding a little mercury.

In selecting pieces of galena the parts that are very shiny and have the most vein will be found to be the most sensitive. When breaking galena do not hit the mineral one hard blow: tap it three or four times lightly with a hammer, breaking it into square pieces, and there will be no waste.

With silicon or ferron as a mineral, use a gold wire having a sharp point. A fairly heavy pressure may be used, and results in a firmer adjustment. The resistance of a crystal is great, and therefore as small a piece as possible should be used.

Different combinations of minerals will often work better than one mineral Galena and graphite, silicon and graphite, zincite and bornite, or chalcopyrites (perikon), ferron and silicon, and galena and tellurium will all work better in combination than alone.

Antenna Circuits in Radio Telegraphy

By John Vincent

IN the two earlier articles of this series, the simple relations between capacity, inductance, wavelength and resonant frequency were explained. It was shown that in a closed circuit such as that of Fig. 1, the maximum current would flow when the impedance (or alternating current resistance) was made as small as possible. It was also shown that by adjusting the circuit capacity *C* and inductance *L*, they could be made to neutralize each other's effects for the particular frequency of the alternator *E*, and that when the circuit was in this resonant condition, the current flowing was dependent only upon the voltage generated at *E* and the resistance *R*.

The relations of inductance and capacity to frequency and wavelength, and those of voltage and impedance to current, exist in "open" antenna circuits such as that of Fig. 2, exactly as in closed circuits like Fig. 1. For most purposes the computations explained in the January article will give good results for either open or closed circuits. The only error likely to cause trouble depends upon the fact that in the elevated part of an antenna circuit there are *both* capacity and inductance. In the closed circuit (Fig. 1) practically all the capacity is lumped together at *C* and nearly all the inductance at *L*. In the antenna, however, for short waves the inductance *L* may be quite small and so the *distributed inductance* of the antenna wires may play an important part in determining the resonant frequency of the system. For most radio telegraphic purposes waves considerably longer than the natural wavelength of the aerial are used, and with these the antenna may be considered to be the equivalent of an inductance, a capacity and a resistance all connected in series.

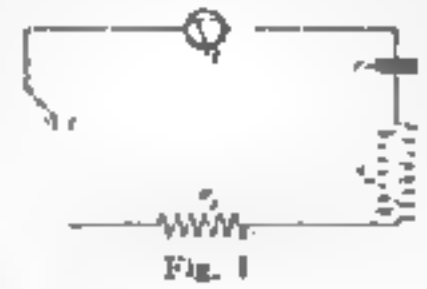


Fig. 1

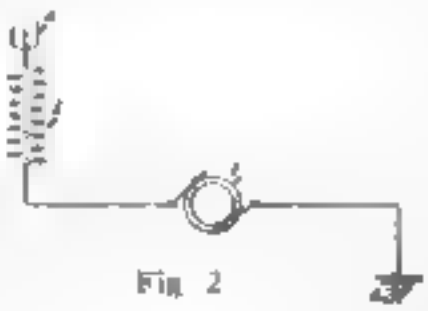


Fig. 2

If one thinks of capacity as a property possessed by any pair of conductors separated by an insulator (which is a correct idea), it is easy to see that an antenna has capacity with respect to the earth. As the two plates of a condenser are separated by an insulator and have capacity with respect to each other, so, in the antenna system, the aerial wires and the earth's surface, (both of which are conductors) are separated by the intervening air. The capacity of the aerial system is a definite quantity depending upon the distribution of current in it, and like that of any other condenser may be computed or measured

Inductance is a property of conductors which makes itself known by the magnetic effects produced upon these conductors when the currents through them *vary*. Since direct current is usually of uniform strength, in direct current circuits inductance is not often considered; nevertheless, the property is always present and ready to become prominent when the current varies. In radio antenna systems, alternating current flows and therefore the inductance of the wires is important. One hundred feet of antenna wire stretched out straight has about 0.07 millihenry inductance, which is equivalent to about *twenty* turns of No. 24 wire wound in a coil of 4″ diameter. For a given length of wire a coil has much more inductance than a straight wire, because each portion of it can act magnetically on the turns beside it. Thus the inductance of an antenna wire can be represented by that of a small coil, just as its capacity may be represented by that of a condenser.

Antenna systems, like other conductors, possess electrical resistance in addition to their capacity and inductance. This resistance is made up of several

parts, one being of the wires themselves and another that of the earth's surface in the neighborhood of the antenna-base. All power losses in the antenna, including that due to the radiation of energy, represent additional parts of the effective resistance. All these component parts are added together to get the true total antenna resistance. For instance, in a large flat top aerial the wires might represent an effective resistance of 0.3 ohm, the ground 0.4 ohm, losses by brush discharge 0.2 ohm, losses at the insulators 0.2 ohm, and the radiated power 0.8 ohm. Added together, the total resistance becomes 1.9 ohms; a closed circuit having the same capacity and inductance as the antenna, and including a resistance of 1.9 ohms in series, would permit the same current to flow as would the aerial when excited by the same frequency and voltage.

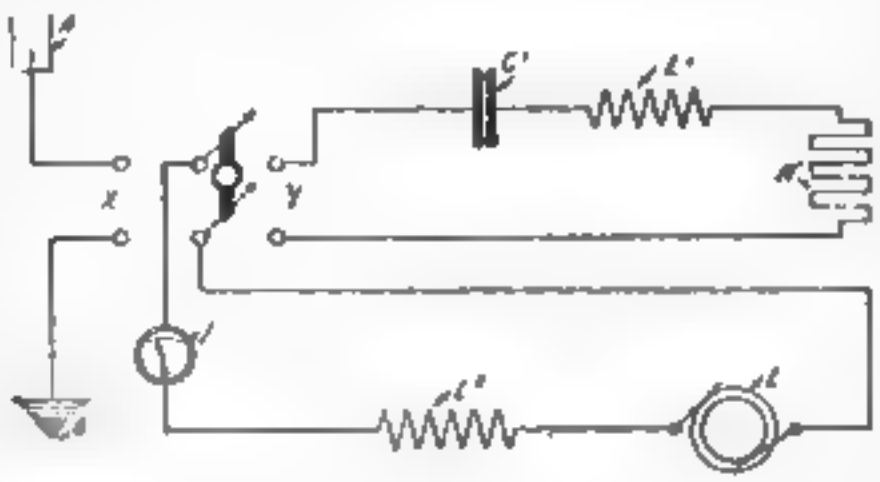


FIG. 3

From the foregoing the fact appears that, for wavelengths long compared to the fundamental or natural wavelength, the electrical properties of an aerial system are in many ways equivalent to those of a circuit containing lumped inductance, capacity and resistance. An experiment with the arrangement of Fig. 3 will show this to be true. In the diagram *A* and *G* represent antenna and ground, which are connected to the "*X*" side of a double-throw double-pole switch. The "*Y*" terminals lead to a condenser *C1*, inductance *L1* and resistance *R1*, in series. Across the center points are connected the radio frequency alternator *E*, the inductance *L2*, and the ammeter *I*. Suppose the switch to be closed on the "*X*" side and the alternator to be generating at 100,000 cycles per second frequency (which corresponds to a wavelength of 3,000 meters). Assuming the natural wavelength of the aerial to be considerably under 3,000 meters, if the inductance *L2* be slowly increased the current reading of *I* will also increase, at first gradually and then rapidly, till it teaches a maximum value. If the inductance is still further increased, the current will grow smaller and smaller. The largest current flows when the effect of the inductance just neutralizes that of the capacity for the frequency used, or, in other words, when the antenna impedance is a mumum. The aerial system reactance is then zero, the impedance is equal simply to the effective ohmic resistance, and the antenna is *resonant* or *tuned* to the alternator frequency. In this condition the current is determined only by the total antenna resistance and the effective applied voltage, irrespective of other factors

If, now, the condenser *C1* is made equal in value to the capacity of the antenna and the coil *L1* adjusted to equal the aerial inductance, the right hand circuit will have a reactance equal to that of the antenna. If the switch is thrown to the "*Y*" position, with the alternator running at 100,000 cycles, and the inductance *L2* is again gradually increased from zero, the current reading of *I* will first increase and then decrease exactly as before. The point of maximum current will appear for the same value of *L2* as when the antenna was connected; if the resistance *R1* is set to a value equal to the total antenna resistance the greatest current in amperes will be exactly the same as with the switch in the "*X*" position.

Thus it is evident that any antenna may be considered as an inductance, a capacity and a resistance in series, and that so far as current and voltage effects are concerned the true aerial circuit may be replaced by an *artificial antenna* consisting of equivalent condenser, coil and rheostat in series. This means that the considerations regarding the impedance of closed oscillation circuits and its arithmetic calculation, as given in the January article, may be applied almost without change to antenna circuits. It is only necessary that the wave-

length used be somewhat longer than the fundamental of the aerial, which is the usual condition of practical wireless telegraphy.

In all the discussions up to this point the use of sustained or undamped radio frequency current has been assumed. The generators indicated by the symbol *E* in the diagrams have been supposed to be radio frequency alternators of the Fessenden type, which produce continuous alternating current of a definite radio frequency depending only upon the speed of the machine. Such an alternator forces any attached circuit to oscillate at the machine's generating frequency, but the amount of the current set up in the circuit depends strictly upon the dynamo's voltage and the circuit's impedance to that frequency. Transmitters of this general type are coming into wider use day by day, as is seen from the work of the Goldschmidt, Fessenden and Telefunken companies. The circuit effects described are substantially identical with those in alternating current circuits operating at commercial power-distribution frequencies of 25 or 60 per second; in the radio work, however, resonant or zero-reactance effects are made useful, and condensers are used directly in the circuits. In low-frequency practice, resonance is usually carefully avoided and series condensers are almost never used.

By far the greatest number of radio telegraph transmitters in use today are of the spark condenser-discharge type. The circuit behavior in these senders is somewhat different from that in the sustained wave alternator transmitters, but most of the basic principles already explained hold true. The main difference arises from the fact that with the alternator the frequency of the oscillations developed depends entirely upon the speed of dynamo and is independent of the circuits connected to it, while in the spark transmitter the frequency depends mainly upon the capacity and inductance of the discharging circuit

Consider for a moment the arrangement of Fig. 4. Here an antenna *A*, which possesses inductance, capacity and resistance, has connected between it and the earth *E* a spark gap *S*. Across the spark gap, by means of terminals *TT*, a high voltage transformer, inductance coil or other charging source is connected. If the potential of this charging source gradually increases, a current flows into the antenna and, because of its electrostatic capacity, this aerial system takes a charge. If the voltage continues to rise until the electrical pressure is so great that the air between the spark gap terminals at *S* breaks down, a spark will pass and the electric charge previously impressed upon the aerial will rush to earth. In an ordinary antenna this discharge to earth will be such that the electrical inertia of the system will cause the charge to "overshoot," in a sense, and the antenna will take on a polarity opposite to that which it had originally but somewhat weaker The insulating properties of the air gap *S* are not regained in the brief time of the charge's passage, and so the current rushes up to the antenna once more; at each swing or partial electrical oscillation the electromagnetic inertia due to inductance causes the effect of "overshooting," and the oscillations continue until the energy of the original charge is used up. The electrical phenomenon is in many ways similar to the mechanical effects which may be observed when a weight at the top of a springy rod (which has its lower end clamped in a vise) is swung back and forth.

Fig. 4

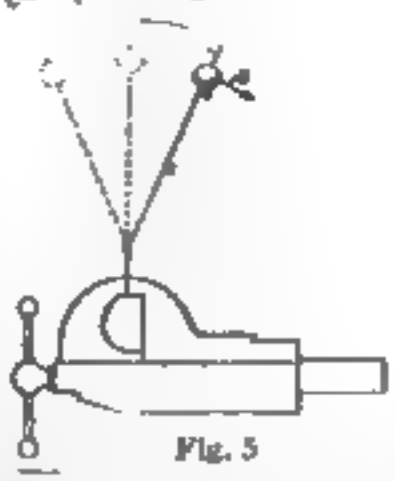


Fig. 5

Consider such a mechanical system, as shown in Fig. 5. If the weighted end *A* is pulled to the right by drawing on the light thread *B*, the spring *C* will be more and more strained until at last a point is reached at which the thread snaps. This is a fairly close analogy to the straining of the air in the spark gap *S*, Fig. 4, as the charging voltage gradually increases to the breaking point. Referring again to Fig. 5, as soon as the "charge" of mechanical energy placed in

the spring *C* is released by the breaking of the thread, the weight *A* swings to the left. By reason of its inertia the weight does not stop at the central normal resting position unless the friction is very large, but "overshoots" and travels off to the left side. But its motion to the left does not carry it so far from the center as it was originally. When it again swings back to the right the displacement is still less; the successive partial mechanical oscillations to right and left gradually become smaller until the energy originally imparted is used up, when the swinging stops.

For every complete oscillation of the freely vibrating antenna system a certain definite time is required. This time, which is usually measured in fractions of a second and is called the *period* of oscillation, depends upon the capacity and inductance of the vibrating system. It is a definite quantity for each amount of capacity and inductance, and, when the resistance is not abnormally high, depends only upon these. If the capacity of the circuit is stated in farads and the inductance in henrys, the time of one complete oscillation in seconds may be found by (first) multiplying the capacity by the inductance, (second) taking the square root of this product, and (third) multiplying the result by 6.28. Thus if the capacity is 0.002 microfarad (or 0.000000002 farad) and the inductance 3.2 millihenrys (or 0.0032 henry), the product is 0.000000000064, its square root is 0.00000253, and the period (multiplying by 6.28) is about 0.0000161 of a second. The frequency is obviously the reciprocal of this, or 62,000 periods per second, which (as shown last month) corresponds to a wavelength of 4,800 meters.

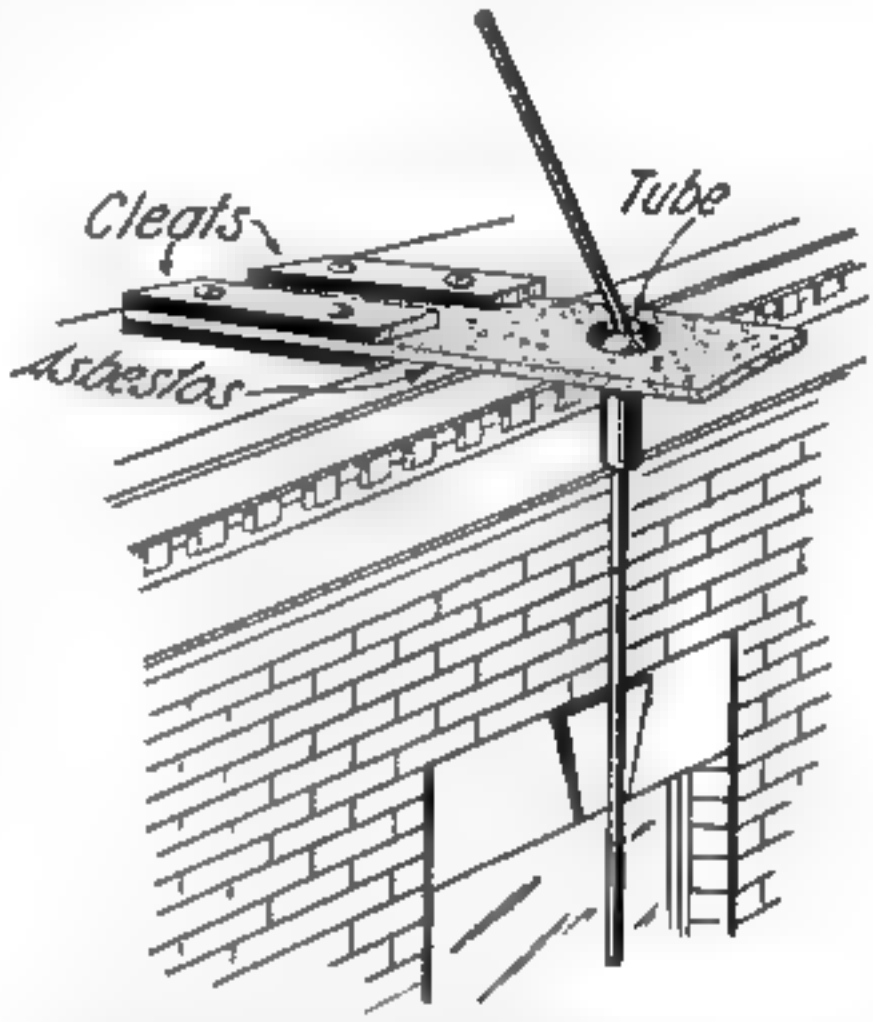
In the next article some of the effects of changing inductance, capacity and resistance in both open and closed circuits will be discussed.

Edison's Railroad Wireless

WIRELESS was used on railroad trains as long ago as 1885, but the system then devised by Edison depended upon static induction and not radiated waves. It has been only recently that radio telegraphy has proved useful in railroad work.

A Roof Insulator

AN insulator for lead-in wires passing over the edge of a house roof may be made by cutting a piece of stiff asbestos and placing it between two pairs of porcelain cleats. A hole is then made in the asbestos and a porcelain tube inserted; the entire insulator is then nailed to the roof and is ready for use. The drawing shows the construction in detail.



This insulator for lead in wires is efficient and easy to make

International Conference at Washington

INTERNATIONAL conferences on radio telegraphy were held at Berlin in 1903 and 1906 and in London in 1912. The next is to be at Washington, D. C. The regulations adopted have been agreed to by most of the countries of the world.

Radio Has Velocity of Light

IN THE experiments between the powerful Navy station at Arlington and that of the French government at the Eiffel Tower, Paris, which were carried on two years ago, it was found that the velocity of electromagnetic waves as used in radio was substantially identical with the speed of light. The measurements were made by taking carefully timed photographic records of signals sent across the Atlantic.

The Static Coupled Receiving Tuner

By John L. Hogan, Jr.

NEARLY all experimenters are familiar with the action of the ordinary inductively coupled receiving tuner illustrated in Fig. 1. With this arrangement of apparatus, if the elements are well designed and manipulated, excellent results in tuning may be secured. The construction is not always easy, however, since the primary and secondary coils must usually be so built that one may slide within the other. It is difficult to devise ways to connect conveniently to various taps on the movable coil without introducing losses in lead wires. Such losses invariably result in weakened signals, and prevent reception of signals from the greatest possible distances.

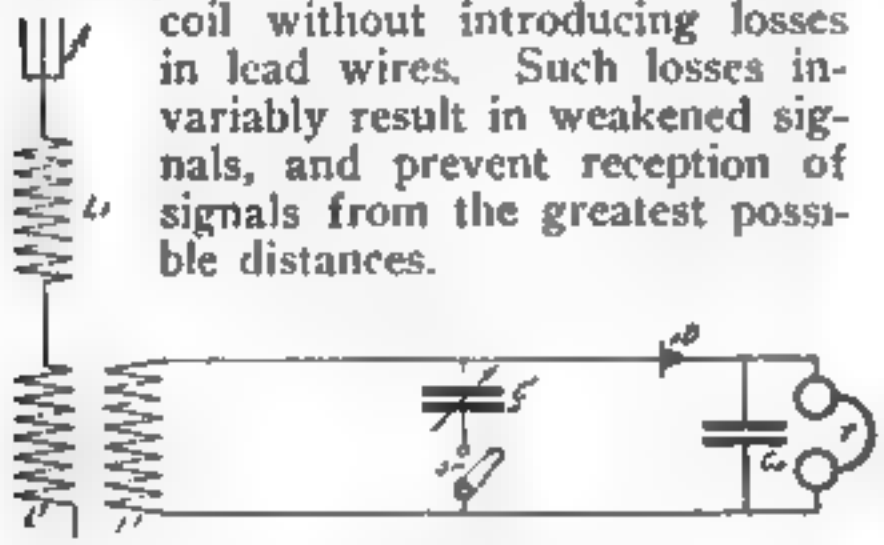


Fig. 1. Magnetic coupling for receiving tuner

A somewhat different type of tuner, which is now coming into rather extensive use, usually gives sharp tuning and loud signals, yet is very easily assembled. The connections are shown in Fig. 2, and may be seen on examination to bear some resemblance to the inductively coupled layout of Fig. 1. In both diagrams the antenna and earth are shown by *A* and *E*, the primary circuit loading coil by *L1*, the primary by *L2*, the secondary by *L3*, the secondary tuning condenser by *C1*, the blocking condenser by *C2*, the detector by *D* and the telephone by *T*. In Fig. 1 the primary and secondary coils are placed rather close together, so that energy may be transferred electromagnetically by the action of the lines of magnetic force linking both coils. In Fig. 1, the mutual inductance of the primary and secondary (and therefore their coupling) is altered by moving the coils toward or away from one another; when near together the coupling is close and the selectivity poor, when far apart the coupling is loose and the selectivity or sharpness of tuning greater. The gain in selectivity is often accompanied by a reduction in signal strength.

In Fig. 2, the primary and secondary coils are set far apart, so that there is practically no magnetic coupling between them. A third condenser, *C3*, which is preferably variable and of small minimum capacity (say of from 0.00005 to 0.001 microfarad range) is put in circuit as shown. This additional condenser governs the coupling of the system; when *C3* has small values the coupling is loose and the tuning sharp, and when *C3* is increased the opposite condition is approached. The two coils need not be moved at all in order to secure any of the desired coupling effects; therefore, either primary or secondary or both may be variometers and the end-switch losses thereby eliminated.

In tuning with the condenser-coupled circuit the ordinary procedure is followed. The coupling is made close and, with the secondary condenser disconnected by opening switch *S*, the primary is adjusted until the desired station is heard with the greatest loudness. The switch *S* is then closed and the secondary system tuned by varying *L3* and *C1*. If interference is present, or if the incoming signals are very sharply tuned, the best results are secured by gradually loosening the coupling and at the same time adjusting *L2* and *C1*, to keep the signals at maximum strength. The resonant wave length of the coupling circuit *L2*, *C3*, *L3*, is generally much shorter than that which is being received. Testing this static-coupled received will be well-spent effort.

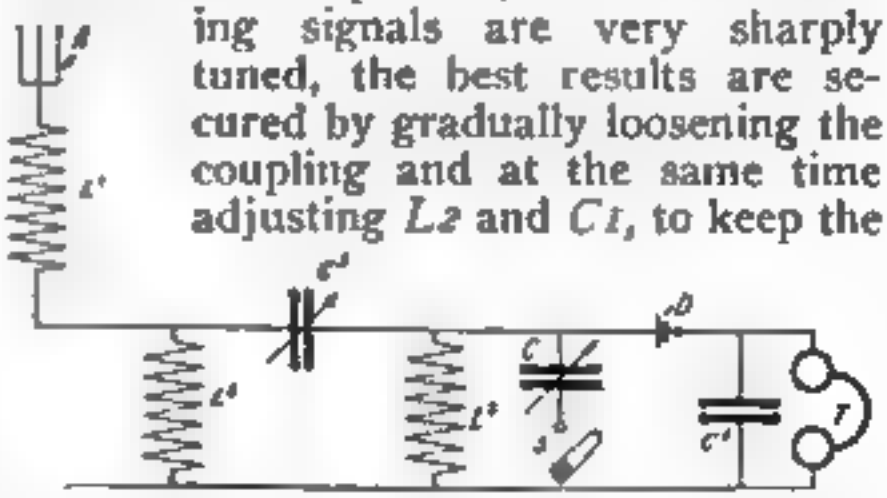


Fig. 2. Static coupling for receiving tuner

A Mexican Radio Station

By Stanley E. Hyde

IN MEXICO at present there are eight radio stations, situated at Vera Cruz, Campeche, Obispo, Maria Madre Island, Mazatlan, San Jose del Cabo (end of Lower California) Santa Rosalia and Guaymas. During the recent troubles in Mexico the rebels destroyed the station on Maria Madre, which is one of a group of three Pacific Coast

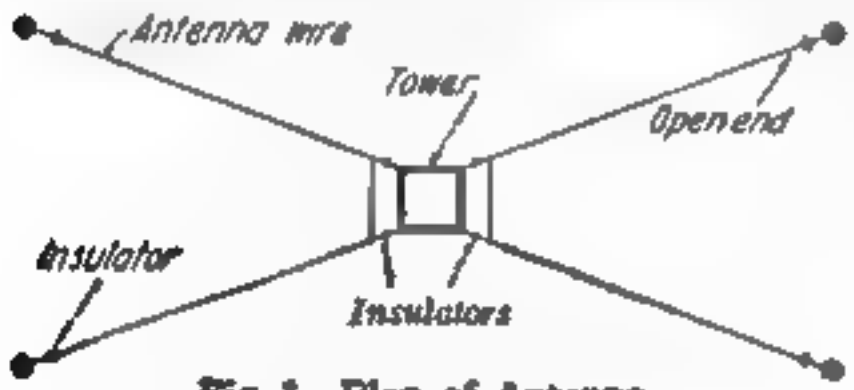


Fig. 1. Plan of Antenna

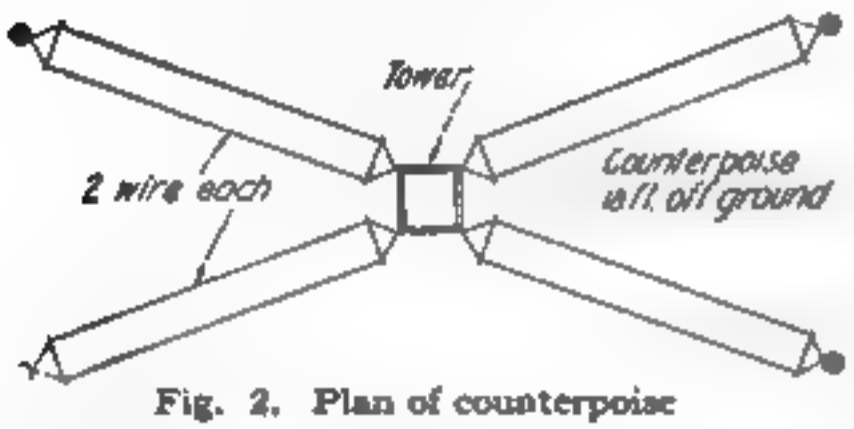


Fig. 2. Plan of counterpoise

islands belonging to Mexico, situated about ninety miles southwest of the State of Tepic. These islands, extremely barren and practically void of vegetation, are surely a most uninviting place for a radio operator.

The station illustrated is that of the Federal government completed during the present year at Mazatlan, Sinaloa, the largest Mexican city on the Pacific Coast. The station is on the top of a hill back a little from the city, and overlooks the ocean. On the side of the hill are broken down barbed-wire fences in great confusion, erected by the Federals to hinder the advance of the rebel forces which about a year ago tried to capture Mazatlan by land and sea. Upon reaching the station one is greatly surprised to find a modern steel tower for supporting the antenna. It is square and gradually tapers to the top, on which is an observation platform which can be made useful for military purposes. The whole, constructed of thin structural steel, is 250 feet high, and guyed by steel cables anchored firmly in the earth. The antenna, which is illustrated in Fig. 1, has distinct features not found in the ordinary radio station, and is especially adapted to the tropics where the static is troublesome. It consists of four wires spread out umbrella style, but not connected together at the bottom. The four spans are brought together near the top and the leads run down from the highest point, as illustrated in Fig. 3.

On such rocky and dry soil it would be impossible to obtain an efficient earth connection so a counterpoise or artificial serial is made use of. Fig. 2 shows a plan of this, which consists of wires supported 18 feet off the ground and insulated from it. These wires are also connected together at the tower terminal and brought into the station through a large lightning switch.

The radio building is constructed of brick and has a red tile roof. Two rooms are used for the transmitting and receiving instruments, while the other three are for the use of the operator and his family.

The transmitter is a 1½ kilowatt Telefunken set, using a 500 cycle alternator, belted to a ten horse-power distillate engine. Directly connected to the

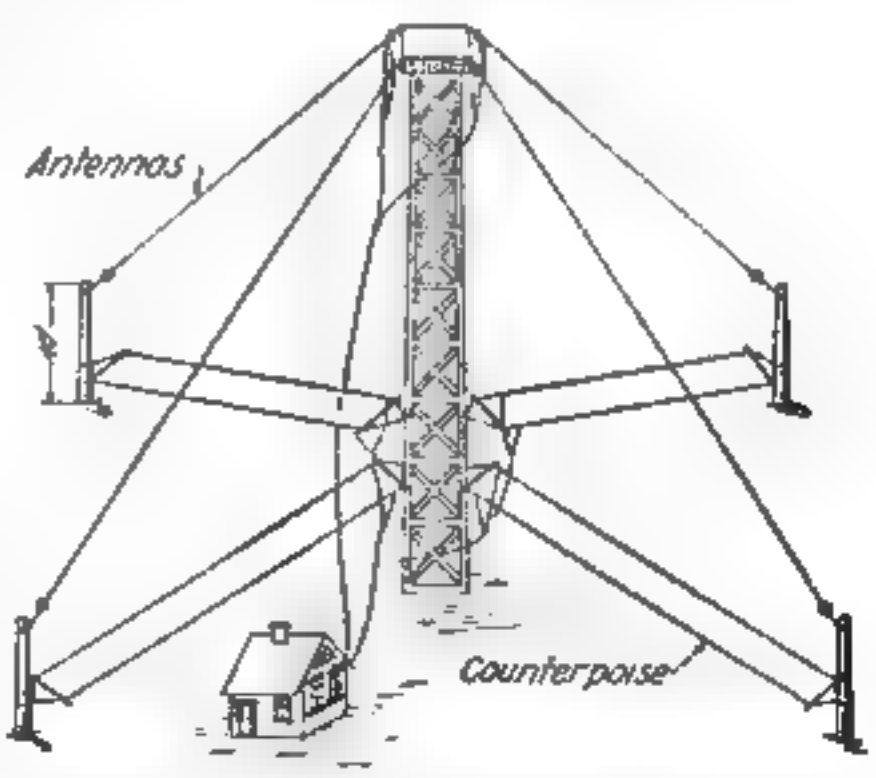


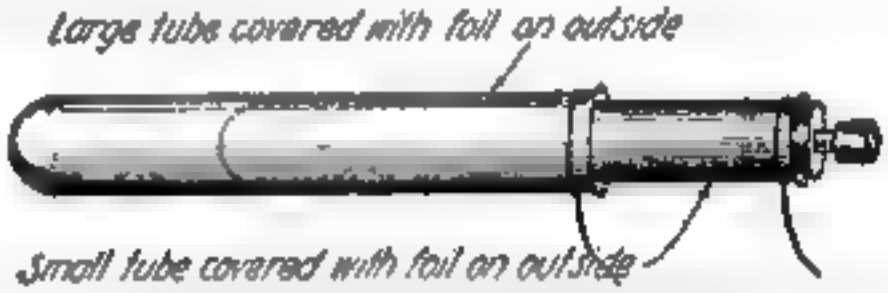
Fig. 3. Diagram of station at Mazatlan, Mexico

alternator shaft is a small direct current exciter. Engine and alternator are situated in a separate room from the rest of the apparatus. The engine is water-cooled by rain water collected in a large tank outside. The receiver consists of a Telefunken loosely coupled set with variable condensers, telephones, two sensitive Galena detectors and transfer switch. To the left of the receiver stand a high voltage tube condenser, the quenched, and variometer inductances. A hot-wire ammeter is included in the antenna circuit.

It is remarkable that this small station can work with Vera Cruz, over mountains and dry places, a distance of nearly 800 miles, but strange things happen in the tropics.

A Variable Condenser

A VARIABLE condenser can be made of two test tubes covered outside with tinfoil, one tube being a little smaller in diameter than the other. The smaller tube is placed inside of the large one, a flexible card being attached to the tinfoil on each. The condenser is varied by sliding the smaller tube in and out of the larger. There may be several sets of these condensers made and hooked up in either parallel or series.



A variable condenser made from two test tubes

Radio Club News

THE Technical Association of Licensed Operators, was formed on October 21, 1913. Meetings are held fortnightly, at which papers are presented and discussed. The present officers are: W. Woodrow, President; E. T. Dickey, Secretary and Treasurer. Other clubs are invited to address communications to the secretary's office, 1649 Amsterdam Ave., New York City.

Radio Club of Redlands

The Radio Club of Redlands, Calif., was recently formed, with an initial membership of nine. The following officers were elected: President and Chief Operator, Ezra Moore; Vice-President, Arthur Munzic; Secretary-Treasurer, Rudolph Kubias, and Asst. Secretary-Treasurer, Harry Williamson. Meetings are held every second Friday evening, at 7:30 P. M.

Amateurs in nearby towns are requested to communicate with the club, at 108 Eleventh Street, Redlands, Cal.

Wireless Club in Salt Lake City

At a recent meeting officers were again elected to positions in the Granite Wireless Association. The club is beginning its second year in amateur radio work and is now studying some of the latest works on Radio under the supervision of Prof. S. H. Besley. Most of the members have stations entirely of their own make and have secured excellent results. They hope to have the largest club of the Middle West and invite communications from other clubs. These may be addressed to Pres. Merton Stevenson, Granite High School, Salt Lake City, Utah. The club's station call is G. W. A. and practice work is carried on the last Saturday evening in each month. Business meetings are held every Friday afternoon, beginning at 2 P. M. at the school building

Pensacola Junior Radio Club

The Junior Radio Club of Pensacola, Fla., recently held its first meeting. The following officers were elected: Edwin Copas, President; Oliver Williams, Secretary; Fred Gillmore, Operator. Nearby amateurs are invited to join. Address communications to Fred Gillmore, 127 W. Gregory Street, Pensacola, Fla.

What Radio Readers Want to Know

Indoor Aerial

C. J., Detroit, Mich., asks:

Q. 1. Would it be possible to use the lighting circuits in the house for an aerial, it being understood that the main switch is open?

A. 1. While not a very efficient aerial system it might be used under certain conditions. If the wires are not placed in metal conduits or in no way grounded, the system could be used. Nothing but local stations would probably be received. Better run a few wires across a ceiling in the top of the house than to try to use the light wires.

Q. 2. If the wires could be used, what would be the wave length of the system? The house is a two-story frame house, with one light in the attic and four in the cellar.

A. 2. It would be impossible for us to estimate the wave-length of the system.

Q. 3. If the bulbs were unscrewed, could this aerial be used to transmit on by using a small coil?

A. 3. No. The potential from the coil would be too high for the wiring and would puncture it at such points as fixtures. Similar trouble is experienced where currents are induced in the house wiring from an outdoor system of aerial conductors.

Radio Telephone

E. J. O'B., Black River Falls, Wis., asks:

Q. 1. Will you please give me the information which will enable me to construct a radio telephone set capable of transmitting one-half mile or farther if possible?

A. 1. We would judge from your letter that you would prefer to have instructions for a set which you could set up yourself, without involving expensive construction costs. For details of larger or more efficient sets we would have to refer you to a text book on the subject as it would be far too long to cover in this column. However, there is in vogue a type of radio which will cover the distance which you desire and which is fairly reliable. Such a set consists fundamentally of a transformer, such as would be used for radio telegraphic work, shunted by a carbon micrometer gap. Connected across the gap are two small condensers in series between which is the primary of an ordinary oscillation transformer. The secondary of the oscillation transformer is connected on one side to the aerial and on the other to the transmitter, the other side of the transmitter being grounded. The condensers are about 0.0025m.f. in capacity and the transformer about ¼ K.W., and should operate on 60 cycles or at a higher frequency if available. The April, 1914 *Popular Electricity and World's Advance*, page 1,466, has a description of such a set and shows the micrometer gap in detail, giving the necessary working drawings. Page 666 of the May, 1914, *Modern Electrics and Mechanics*, describes a similar set, but omits details of the spark gap.

Multiple Tuner

A. F., Rochester, N. Y., asks:

Q. 1. Is it absolutely necessary to use No. 24 wire on the multiple tuner described in the September issue of the *World's Advance?*

A. 1. By changing the size of the wire the most important change in the characteristics of the tuner will be the wave length, to which it will respond. By increasing the size of the wire the wave length to which the tuner would respond would be decreased.. By using smaller wire the respondent wave length would be increased. In this particular tuner it would be possible to use any size of wire from about No. 23 to No. 38, bearing in mind, of course, the change in the respondent wave length. For your purposes we do not believe this change would be of any great importance to you.

Q. 2. Is it also necessary to use enameled wire?

A. 2. Enameled wire permits the greatest number of turns to be placed on the coil and increases the respondent wave-length over that available with other types of windings. Spaced bare wire or single cotton or silk covered wire may be used quite satisfactorily

Receiving Set

E. E. Z., Long Island City, N. Y., asks:

Q. 1. Please give me the dimensions of a receiving transformer to use with an audion detector to have a range of 200 to 1,500 meters. I desire to use switches instead of sliders.

A. 1. Wind 150 turns of No. 28 S. C. C. magnet wire on cylinders 5¼ and 4¾ inches in diameter respectively and five inches long. You can arrange the taps to suit yourself. On the primary we would suggest that you make arrangements for tuning to every other turn, and on the secondary ten points would be sufficient.

Q. 2. Please give me the dimensions of a loading coil to increase the range to 4,000 or 5,000 meters.

A. 2. Wind No. 28 S. C. C. magnet wire

on a cylinder 5¼ inches in diameter and 15 inches long. You should place about 500 turns on this coil.

A. 3. What is the approximate capacity of a 17 plate rotary condenser whose plates are 4½ inches in diameter and a separation of about 1-16 inch?

A. 3. We assume by a 17 plate condenser you mean 17 rotary plates. Thts condenser would have a capacity on the order of 0.0008 m.f

Receiving Distance

B. R. J., Omak Wash., asks

Q. 1. I have a circuit of No. 14 copper wire, 475 feet long, strung from comb to comb of buildings. I wish to use this as an aerial by placing a gas pipe in the center of the span, raising it to 92 feet above the ground. Using silicon or other crystal detector, what is the prospect of getting at least time signals from Mare Island Navy Yard, 800 miles south of here or from Bremerton, about 140 miles west of here. I am located east of the Cascade mountains in the Okanogan Valley of Washington.

A. 1. It is very difficult to say just what a station will do when the station is located behind a mountain range, but if you use an efficient set we do not see why signals should not be received from Mare Island. If you used galena instead of silicon you would probably have better luck. Be sure to insulate your antenna well from the gas pipe pole This will prevent serious difficulties.

Armstrong Circuit

F. F. L., New Rochelle, N. Y., asks:

Q. 1. Can the Armstrong circuit be used on wave lengths of from 150 to 3,000 meters? If so what size coils should he used?

A. 1. The circuit itself is all right, but it is very difficult, if not impossible to get the audion to oscillate satisfactorily in a wave length of 150 meters. It is possible to get it to work on the longer wave length you mention. As the sustained waves are almost by absolute necessity of a long wave length there is very little need to get the audion to respond to the shorter lengths, as it is fully as effective to receive there the spark frequency rather than the radio frequency.

Single Radio Receiving Station

C. O. T., Easton, Md., asks:

Q. 1. What instruments do I need to receive messages 500 miles?

A. 1. Some form of tuning coil, preferably a loose coupler, many of which have been described in the columns of this publication; a detector, a mineral such as galena would probably be most satisfactory to start with; a high resistance receiver, a 2,000 ohm set is quite satisfactory, and a small stoppage condenser is all that you would require. Better results would be obtained by adding a variable condenser across the secondary of the loose coupler, but this is not absolutely necessary.

Q. 2. What kind of an aerial would you use?

A. 2. The easiest to erect, is about the usual answer. Almost anything will do. Look around and see a few other aerials and you will get a good idea of what you think would best suit your needs. We would suggest that you buy, if not otherwise possible to obtain, a copy of Edleman's book on "Experimental Wireless Stations." This book will answer both questions 1 and 2 with far more detail than is possible for us to do here. It will also give you a very good elementary knowledge of the entire subject.

Q. 3. We have a 32-volt storage battery house lighting system for house lighting. Can I use this on my receiving set?

A. 3. No battery is required for your receiving set.

Loose Coupler

J. F. E., Pittsburgh, Pa., asks:

Q. 1. Is it necessary for me to build two loose couplers in order to receive wave lengths of 150 meters up to 3,000 meters, or would one loose coupler be sufficient without bothering with the dead end effect?

A. 1. Unless you desire the highest possible efficiency, one loose coupler will be sufficient for your needs. The amount of dead end effect will be small and will not cause a great deal of loss. If so desired you could sectionalize the coils by inserting one or more switches, but we would not consider this absolutely necessary. Unless you have a very small antenna it will not be possible for you to receive wave lengths as low as 150 meters without inserting a condenser between the aerial and the primary of your loose coupler. If you desire to receive wave lengths of 150 meters, your aerial including all leads should not have a total length of over 50 feet. Satisfactory operation may be obtained from aerials whose total length is 125 or possibly 150 feet if the series condenser above referred to is used.

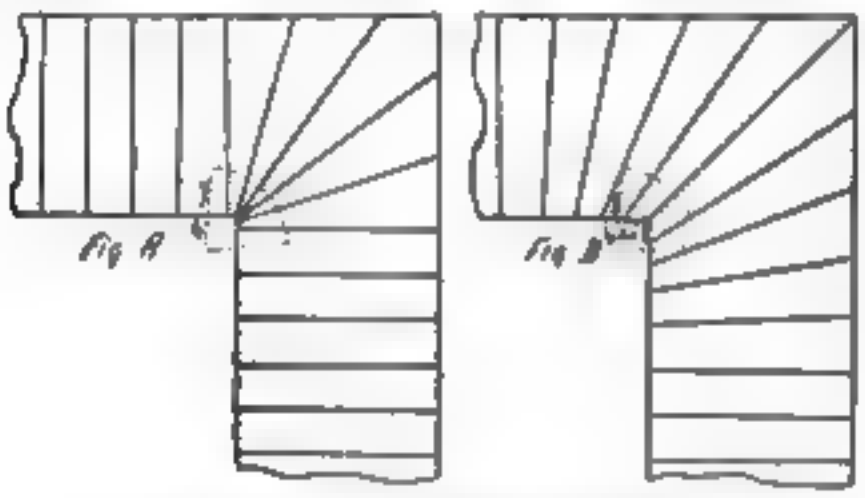
Q 2. What number wire should I use to build a loose coupler which will tune to 3,000 meters?

A. 2. Wind the primary with No. 24 S C. C. magnet wire, and the secondary with No. 26. The primary cylinder should be 5¼ inches in diameter and the secondary 4¾ inches. Both cylinders are 7 inches long.

The Home Workbench

Avoiding Dangerous Stair Turns

THE turn of an ordinary narrow staircase is so sharp and the steps at the inner part of the turn so narrow that a person in a hurry is likely to stumble and fall. The danger of injury can be considerably reduced by construcing the stairs with the steps



The usual way of building stairs (Fig. A), and the more intelligent scheme of widening the inside steps at the turn (Fig. B)

wider at the inside of the turn. To accomplish this, more steps must be allowed for making the turn.

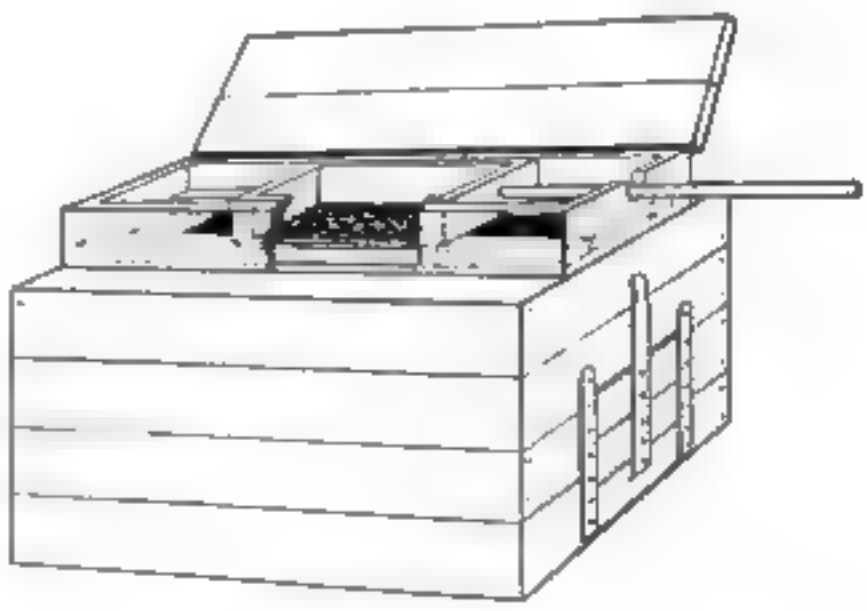
Instead of the usual sharp right angle, each succeeding step should be cut at an increasing angle, so that double the number of steps are required in constructing the turn. By a comparison of the two drawings, it is readily seen that the breadth of the step on the inside of the turn meant comfort and safety in a narrow passage.

A Dustless Ash Sifter

THAT unhappy Saturday morning task of the small boy—sifting ashes—may be brightened to some extent by a comparatively dustless ash sifter. Certainly, a device of this sort will be welcomed by the housewife, who listens with consternation to the grating sound of the ash-sifter, fully aware of the disaster that powdered ashes wreak on lace window curtains and polished wood work and furniture.

The dustless ash sifter consists of two boxes, one for sifting the ashes, the other for receiving the waste. The lower box is large, and fitted with a sliding door at one end for removing the ashes when it is filled. The upper box is nailed over a long hole in the top of the other, and is provided with a hinged cover. At one end of the small box a hole is cut to admit the handle of the sifter. The sifter, itself, consists of a flat wooden frame, made box shaped, from four narrow boards. It is open at the top and screened at the bottom.

The ashes are placed in the sifter, the hinged top is closed, and the handle is moved back and forth. Unusable ashes fall into the bin below; clinkers and unburned coal remain on the screen.



A packing box, properly adapted, becomes an excellent dustless ash sifter

An Outdoor Window Bed.

A CLEVER Los Angeles club-woman has invented a window bed which can be used for several purposes. It may be used, for instance, as an attachment on a window, whereby a fresh air lover can sleep with his or her head out in the open (Fig. 1). The head is protected from mosquitoes in summer by a metal screen box fitting tightly over the head of the bed.

By making a few changes in the framework, floored tent or movable playhouse for children is erected. This can also be made 7 feet tall for adults, merely by extending the metal posts.

Figure 2 shows how the device can be converted into a flower stand outside the window and a table inside the window. In Figure 3 it is a plain bed.

There are many further possibilities of this versatile bed as an elevated platform for travelling speakers, as a children's theatre stage, as a display stand for itinerant peddlers, and patent medicine men. For further outdoor uses it can be transformed in a few minutes to a portable two-shelf flower-stand (Fig. 4), or a lawn settee.

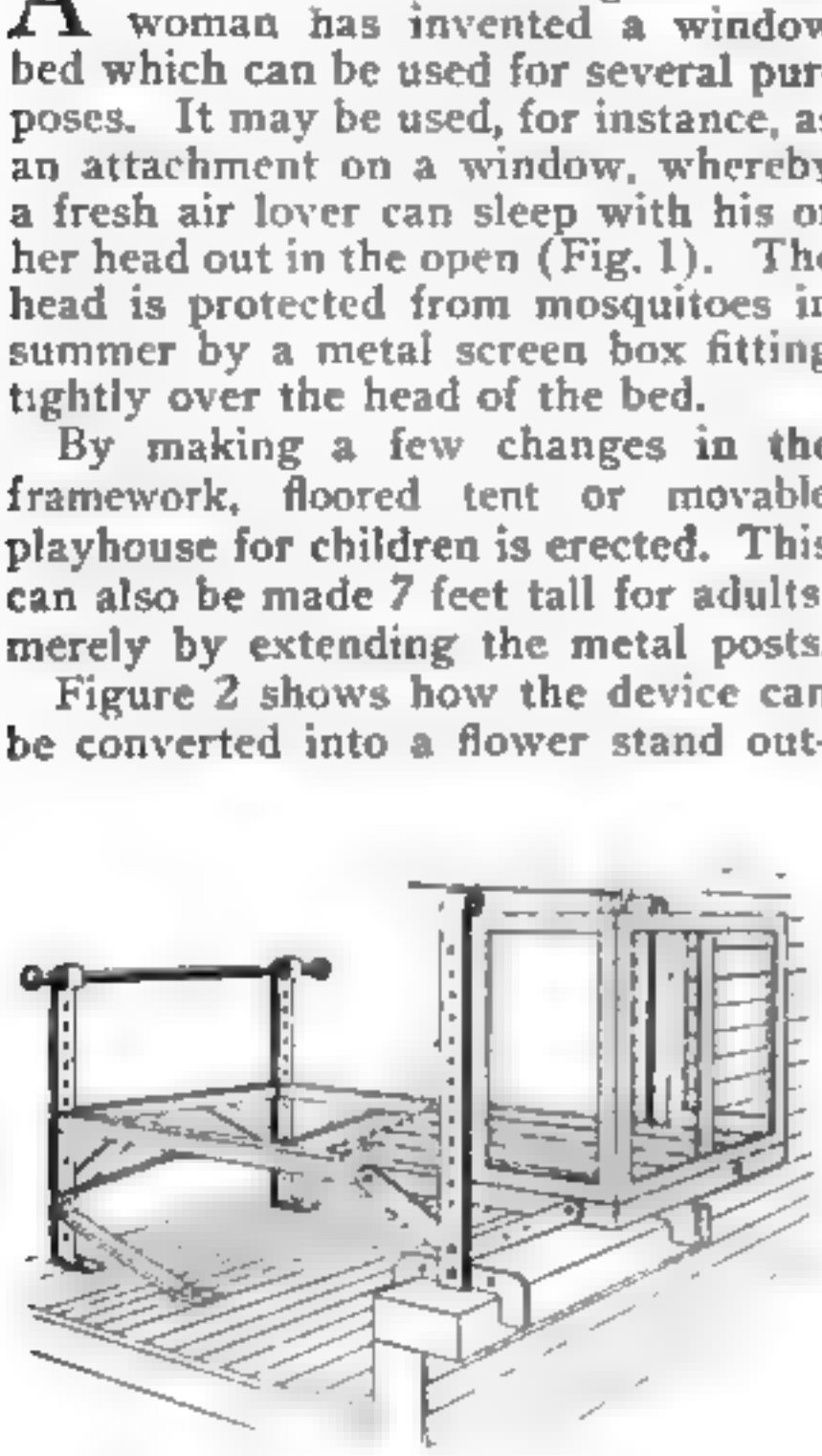


Fig. 1. Outdoor sleeping becomes simple without a sleeping porch

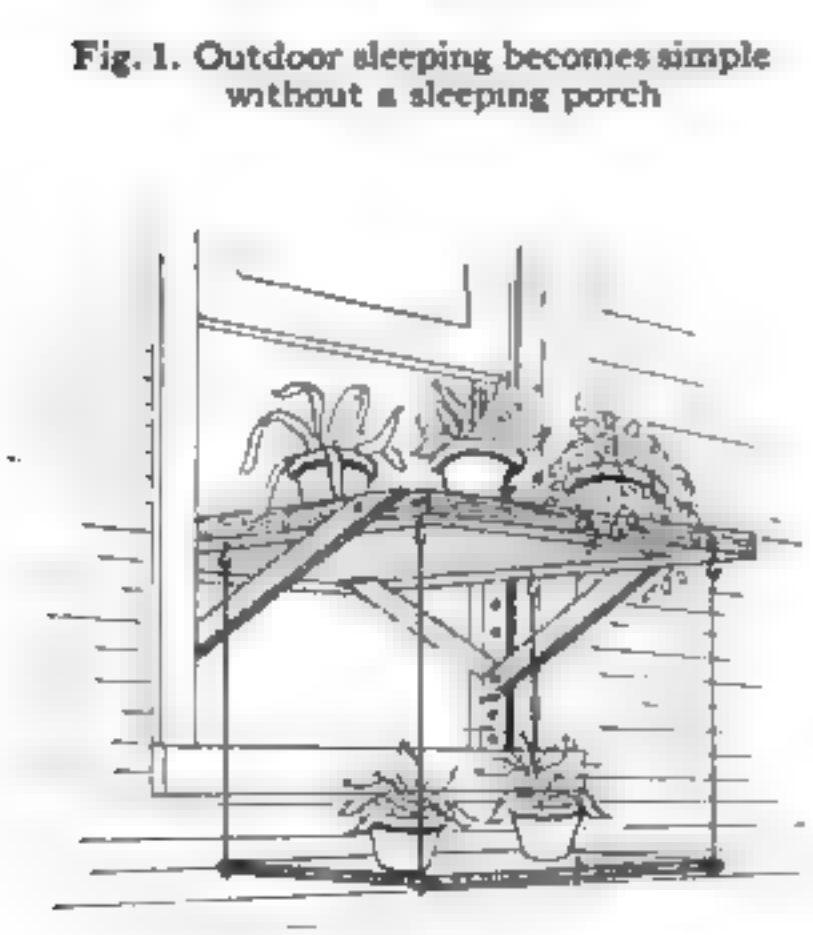


Fig. 2. In summer the arrangement can be used as a flower pot support

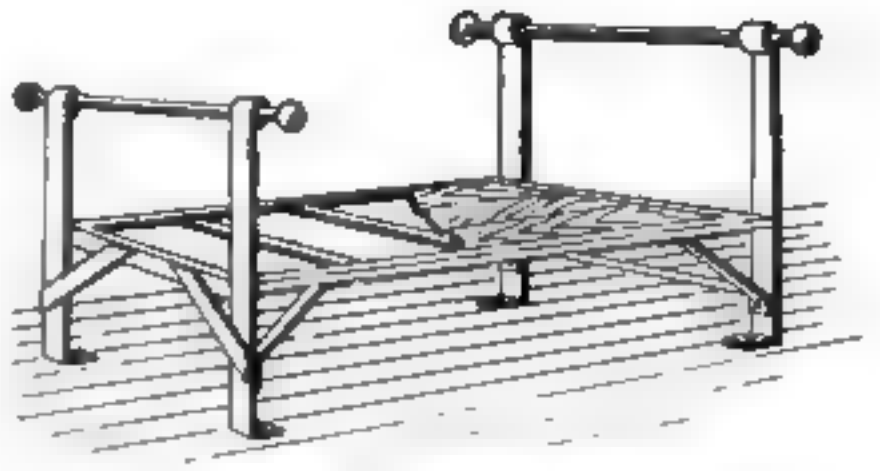


Fig. 3. How the arrangement becomes a plain bed

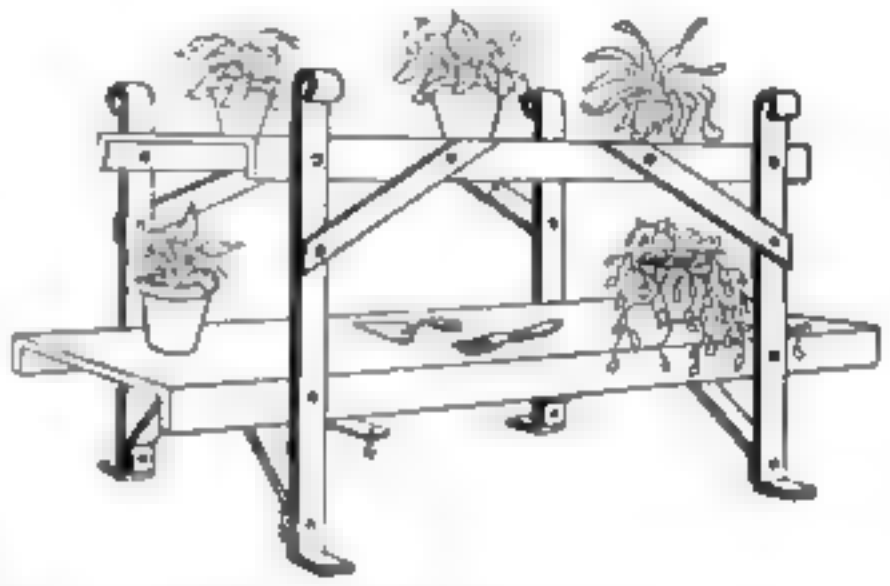


Fig. 4. The same piece of mechanism made into portable two-shelf flower stand

For the Amateur Painter

WHEN painting sash-windows it is very hard not to get any paint on the glass. Any attempt to wipe off the paint from the glass means wiping paint from the freshly-coated sash, too.

To remedy this take a cake of soft soap and rub it on the glass close to the sash, making a 2″ margin. The sash can then be painted without being careful about the glass. When the paint is dry wipe the soap from the glass and the paint will come off the glass, too.

How to Make a Simple, Automatic Window Closing Device

THE object of this device is to enable one to sleep in a room with the windows open during cold weather without the disadvantage of having a cold room in the morning. Briefly, it consists of an electro-magnetic latch which holds the window open during the night until at some predetermined hour, early in the morning, an alarm clock operates a switch in the latch circuit which releases the latch and allows the window to close.

The operation of this latch is as follows: When a current passes through the magnet winding (Fig. 1) the armature is drawn in toward the magnet which releases the hook. As the hook falls, the window no longer being supported, closes. It is, of course, necessary to fasten a weight to the window, or remove the window weights, so that when it is not supported by the hook it will close because of its weight. When the window is closed the hook remains in the position shown in dotted lines in Fig. 1. As soon as the current ceases to flow through the magnet winding, a spring (not in the drawing) moves the armature back to its original position. When the window is again raised the top of the ring striking against the hook carries it up with it until the hook automatically locks into position. The window will then remain open until a current again passes through the magnet winding.

The construction is as follows:

The yoke piece may be cut out of a piece of iron or cold rolled steel 2½" x 1½" x ¼". Two pole cores of the same material about ⅜" in diameter are riveted to this yoke piece as shown in the drawing. The magnet spools may be formed out of brass, or some insulating material, and wound with No. 20 B. & S. gauge single cotton covered wire.

About 5 oz. of this wire will be required. The armature should be cut out of a piece of 1/16" sheet iron and bent up at the top to form a bearing and at the bottom to form a support for the hook. The base, the hook, and the ring should be cut out of ⅛" sheet brass. A spring must be provided to keep the armature over against the adjusting screw when the magnet is not energized. A suitable spring for this purpose may be formed by winding No. 23 B. & S. gauge phosphor-bronze wire on a rod 3/16" in diameter. This spring may be supported on a rod between the two magnet spools. This spring support rod should be just long enough to keep the armature from coming into contact with the pole core ends when the magnet is energized.

For operating this device use an ordinary alarm clock, the only requirement being that it shall have an alarm winding key which rotates as the alarm rings.

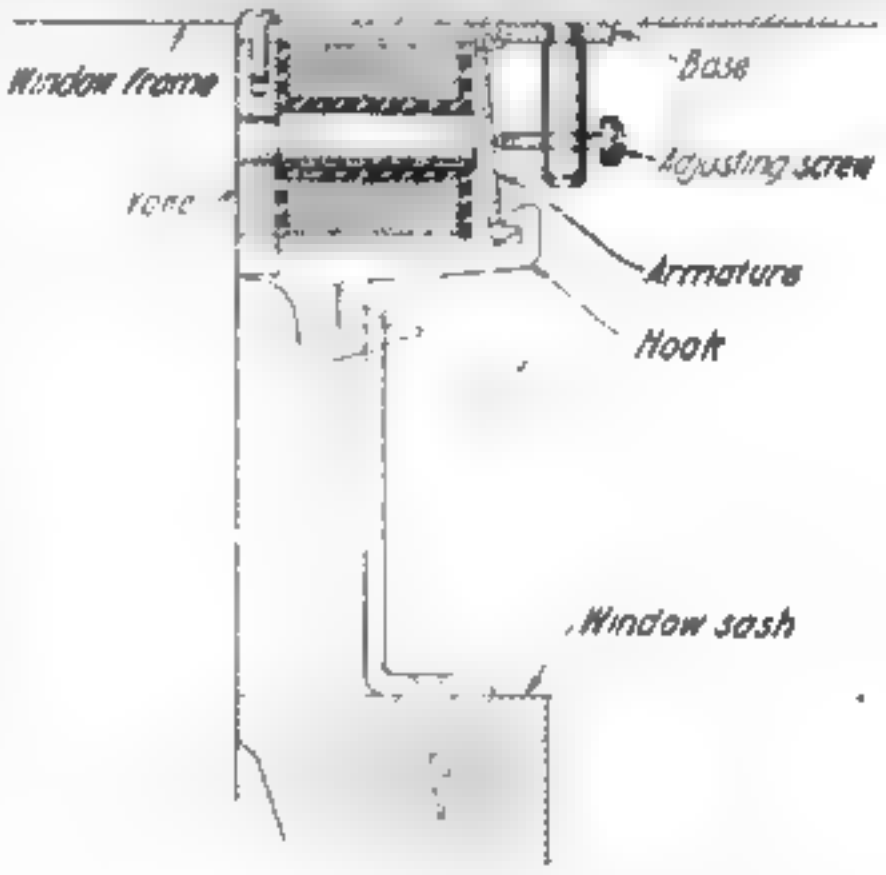


Fig. 1. The latch, showing its operation

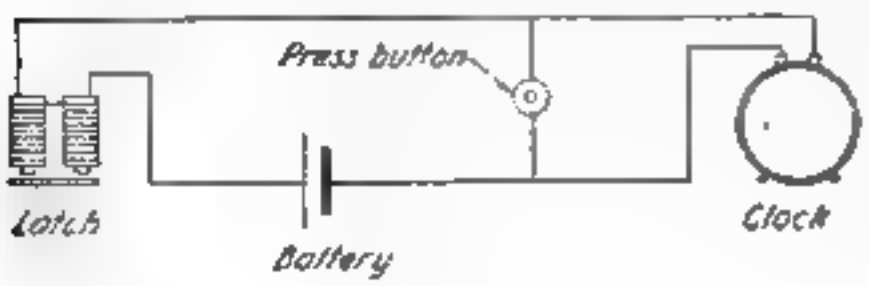
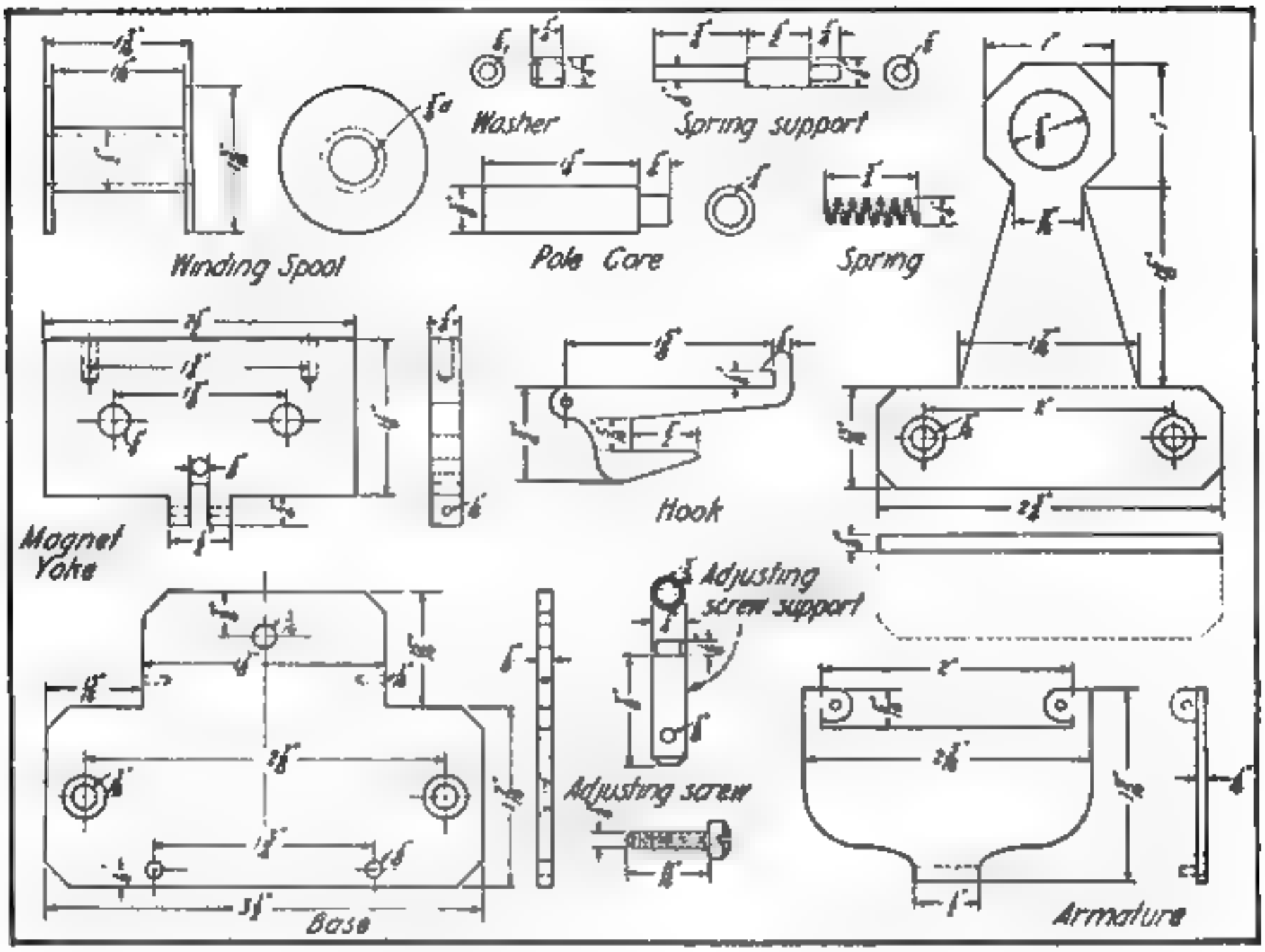


Fig. 2. Diagram of connections



Details of construction of window opening device

Two binding-posts are fastened to the back of the clock. One post is in electrical contact with the frame of the clock while the other is carefully insulated from it. A flat spring is attached to the insulated binding-post and bent into such a position that the alarm key will come into contact with it as it rotates. It is not necessary to wind the alarm up completely but only to give it a fraction of a turn so that in unwinding it will touch the flat spring in passing.

The apparatus should be connected up as shown in Fig. 2. One dry cell is sufficient to operate this device. A press button switch may be included in the circuit as shown in Fig. 2. This press-button is for use when it is desired to close the window at any time other than that for which the alarm clock switch is set.

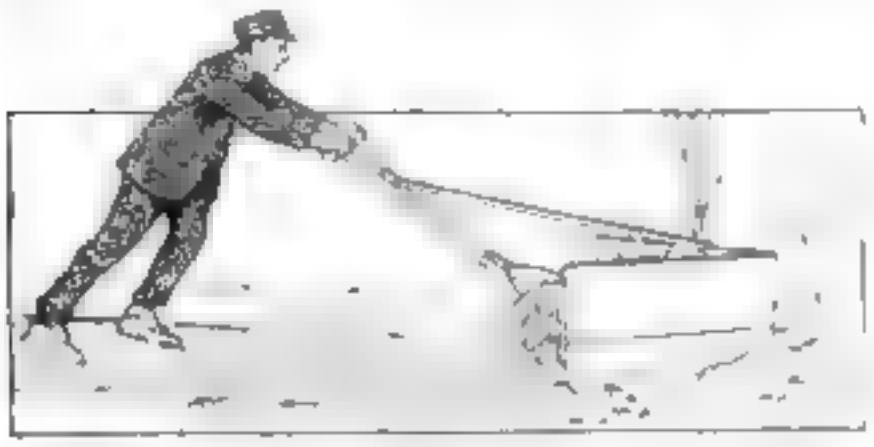
One alarm clock switch may be used to close any number of windows at the same time by simply connecting the magnetic latches on the different windows in series. It will, of course, be necessary to increase the number of cells in the battery if more than one window is to be operated.

For Conserving Heat in Steam Pipes.

AN excellent covering for steam pipes may be made from materials that are almost always available. Take some fine sawdust and screen it through a sieve to remove any foreign bodies Prepare a thin paste of flour and water, and mix the sawdust thoroughly with this paste. With a small trowel, the mixture so prepared should be applied in about 5 coats to the steam pipes while they are slightly warm. Each coat should be thoroughly dry before the next is applied. If the steam pipes are in an exposed situation, 3 or 4 coats of coal-tar should be applied after the paste has dried; if inside a building, this waterproofing is unnecessary. Steam pipes treated with the sawdust as above lose very little heat and, in addition, the mixture is much cheaper than patented preparations.

How to Make a Snow-plow to Clean the Sidewalk

THE plow is built on a lawn mower, the blades of which have been removed. In the drawing the plow is made from a shovel. One of the halves is put on each side and brought to a point in front. The frame is made of one board about 1″ x 12″ or two boards 1″ x 6″.



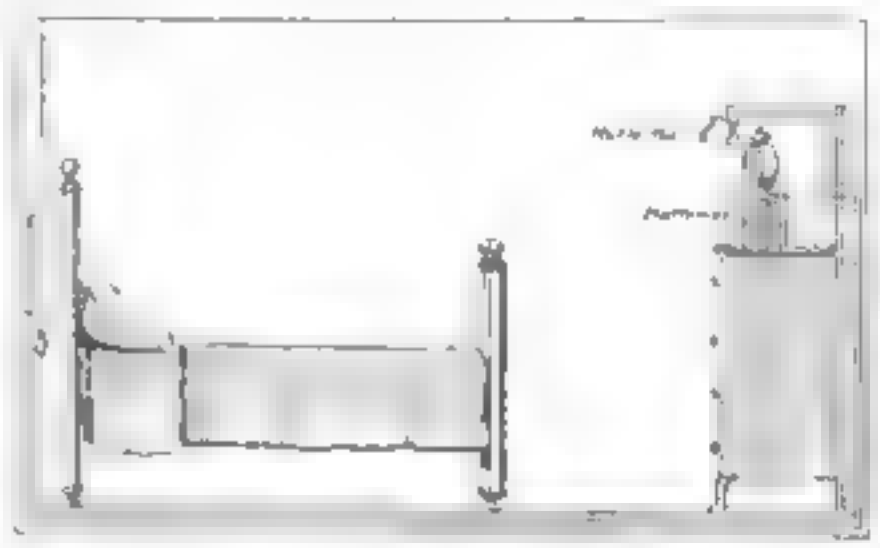
This snow-plow is made from a lawn mower from which the blades have been removed

As the sizes of lawn mowers vary, so will the plow have to vary to fit. The cross-bar is the width and thickness of the handle of the mower, and can be adjusted. It keeps the nose of the plow on the ground.

A Clock Light for Dark Mornings

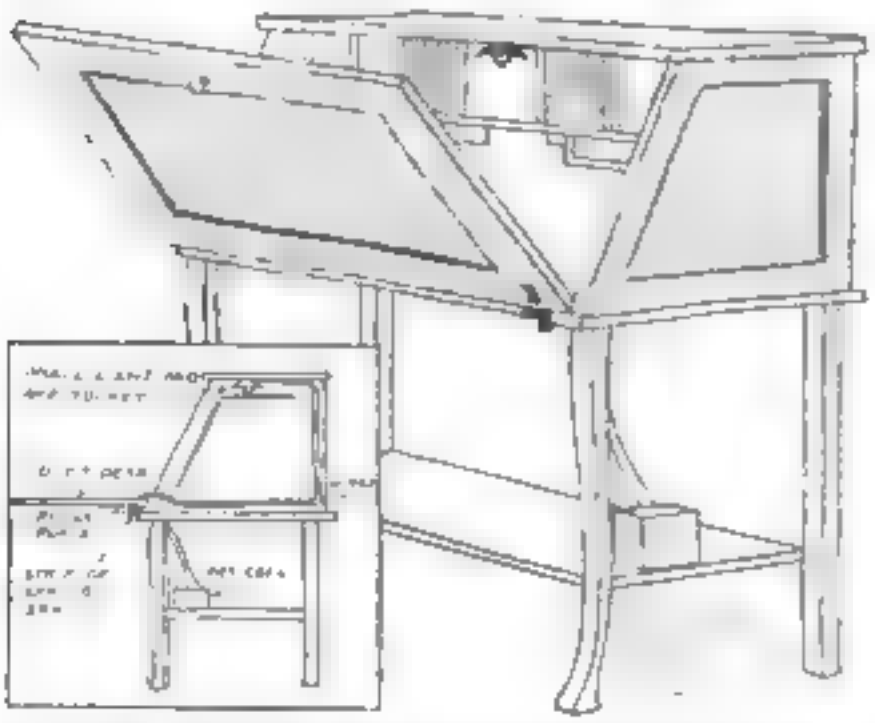
A BOY of fourteen, who has had no instruction in electricity, and whose home in a little Iowa town has no electric service, invented the device illustrated. In this home, early rising is the rule, partly from necessity and partly from choice. In the winter time, when the days are short, he must rise before there is much daylight. This arrangement enables his father or mother to illuminate the dial of a clock and to see what time it is without getting up.

As the diagram shows, two dry batteries are connected in series and put into a little wooden box, on top of which the clock rests. To the back of the box is fastened a light bracket made of strips of soft wood. This bracket overhangs the clock, and to its underside is fastened a three-volt searchlight bulb in a minature base. From one pole of the battery a wire is run down behind the dresser, under the carpet to the bed, up one of the bedposts, to a height about a foot above the mattress. Here a push-button is attached. The return wire goes back over the same route, up behind the dresser to the lamp, and from the lamp to the other pole of the battery. Hanging in front of the lamp is a little piece of tin bent so as to make a crude reflector, at



A push button beside the bed allows the boy to see what time it is without getting up

the same time that it serves to keep the light of the lamp out of the observers' eyes. By pushing the button the dial is illuminated, and the occupant of the bed can read the time without rising.



When the lid is lowered the switch automatically closes the circuit and lights the desk lamp

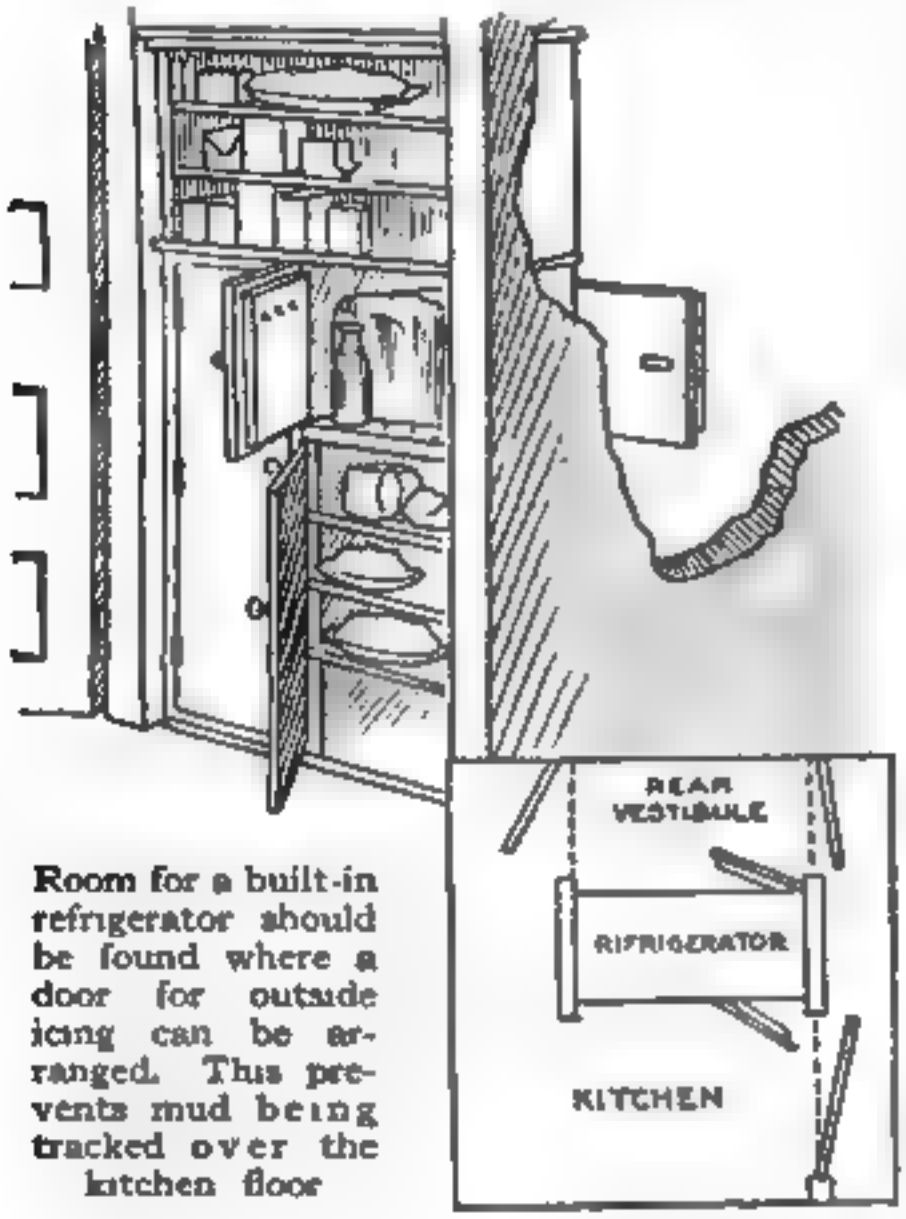
An Automatic Desk Lamp

A CONVENIENT automatic desk light may be easily constructed from two pieces of thin brass, a small light bulb with socket, and a dry battery. A piece of brass is screwed to the desk lid, as shown, and the other piece is fastened underneath it, so that when the lid is lowered the two pieces close the circuit to light the lamp. A switch may be placed in circuit so that the lid may be lowered without lighting the lamp. The wires are placed as illustrated.

Making Use of Cupboard Space for Refrigerator

THE location of a refrigerator in a certain home was an afterthought. No convenient space was available—apparently. The housewife tackled the problem and finally had a bright idea There was a large cupboard built into the wall separating the kitchen from a small rear vestibule. It had large drawers beneath and shelves closed by doors above.

She measured the space occupied by



Room for a built-in refrigerator should be found where a door for outside icing can be arranged. This prevents mud being tracked over the kitchen floor

the drawers, and she and her son divided up the list of dealers in refrigerators, spending each half day in the search of an ice box to fit into the drawer space. Persistence was rewarded at last. A carpenter was hired to remove the drawers, cut the wall, and install the refrigerator, which was chosen with a rear icing door. The doors were also removed from the upper part of the cupboard and the shelves, now open are used for staple groceries.

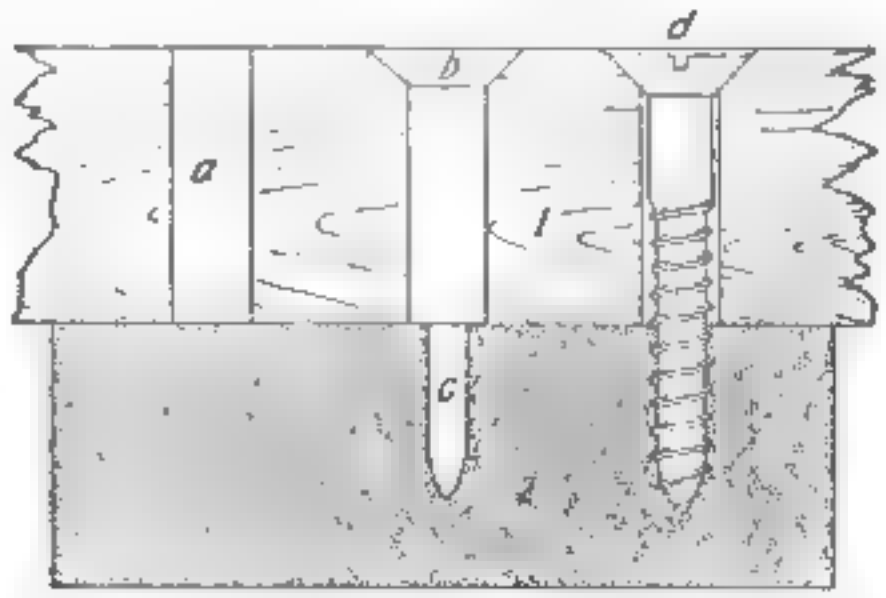
The location of the icebox is convenient in its relationship to the other working equipment of the room. The iceman can fill the box without tracking mud over the kitchen floor. If the family is away the two inner doors of the vestibule can be locked and the outer left open for the delivery. During the late fall and the winter the icing door is left open and the refrigerator keeps food well without ice, which would not be possible were the box entirely within the warm room.

Fastening Wood With Screws

WHEN the wood screw is used for fastening wood together, its functions are, firstly, to draw the pieces into close contact, and secondly, to hold them firmly. Driving a screw, as illustrated, is one of the simplest processes in woodworking, but until experience has taught the amateur better, he usually tries to force the screw through piece 1 by main strength or bores a hole so small that the screw must be turned in with a screw driver. In neither case will the screw draw the pieces more closely together than when the screw entered piece 2.

The hole at *a* should be large enough to allow the thread and the shank to be pushed through with the fingers, but not so large that the head of the screw will not have a good bearing at *d*.

It is not customary to countersink the screw hole in soft wood as at *b*, or to bore a hole in piece 2 to receive the thread as at *c*, as the screw head can usually be turned into the wood by the drawing of the thread in 2, until its head is sunk a little below the surface of 1 as at *d*. In hard wood the hole in piece 1 should be countersunk as shown, and a hole about the size of the core of the thread bored at *c*, in piece 2; if this is not done the screw may be twisted off



The correct way to use wood screws

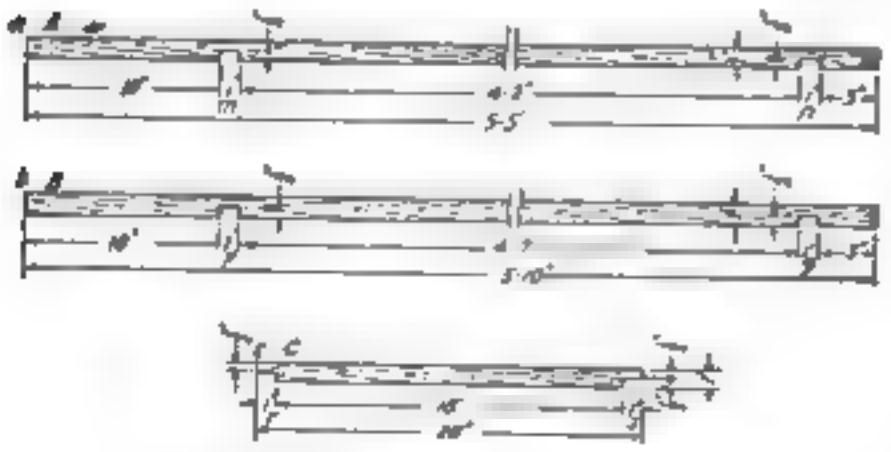
by the force applied to the screw driver, though if the screw is lubricated by being pushed into a piece of yellow soap it may be driven more easily; this is often necessary even if hole *c* has been bored.

To Make a Mission Screen

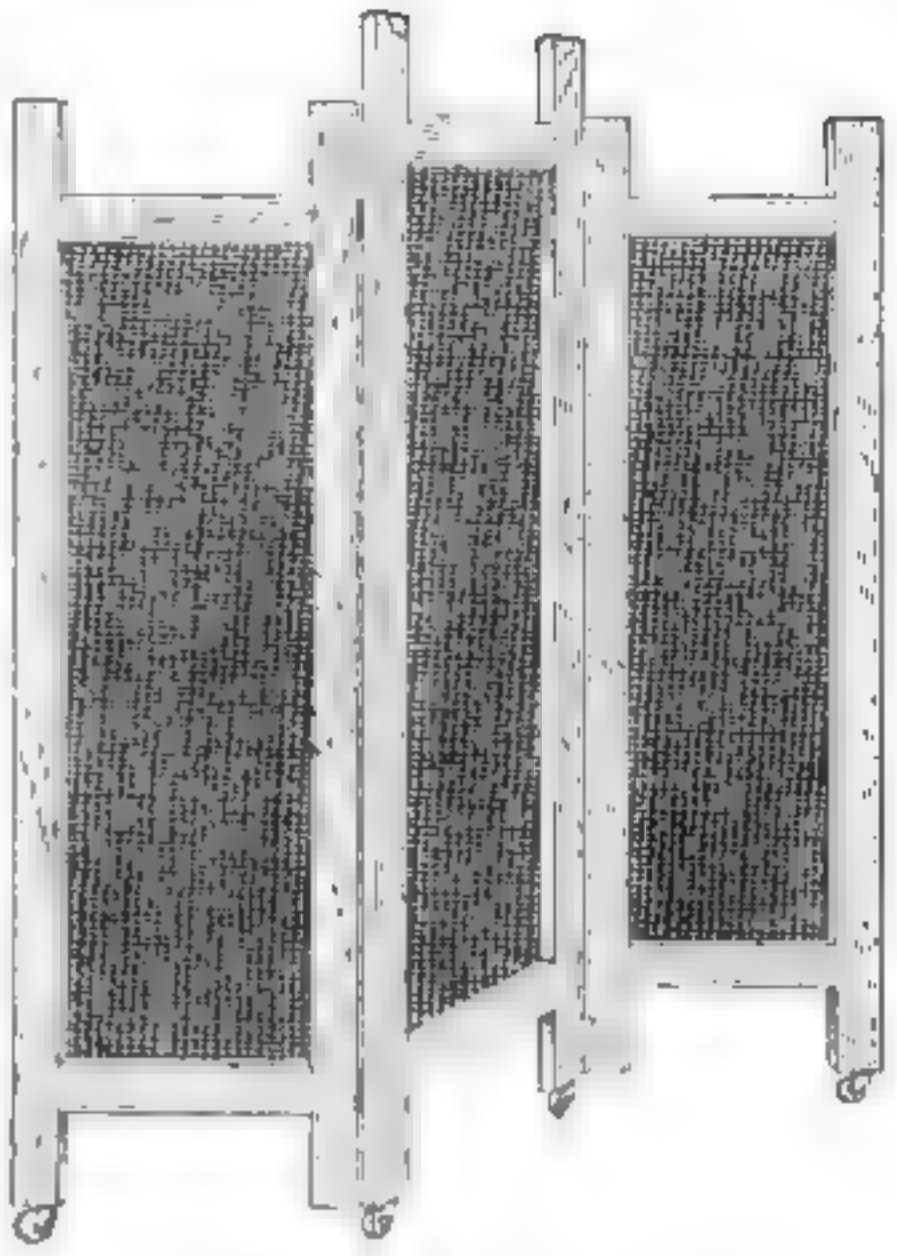
ALL the tools necessary for making a screen are a hammer, a few fine nails, a saw, plane, gimlet, rule and glue pot. The necessary material may be found at most sash and door factories or planing mills free of cost. They are: Four pieces like *A*, 2 like *B* and 6 like *C* in 1″ boards. If possible obtain pieces of the same wood, ash or elm being preferred.

If no work bench is available, nail a ½″ piece to the floor and by using this to keep the stick from sliding, plane sides smooth and sandpaper. Then take two pieces of *A* and the two *B's* and at *a* and *b* bore holes for the casters. Cut in all the *A's* and *B's* ½″ cuts at *m*, *n*, *p*, *q*. Then with knife or chisel break out the pieces and square the holes. Cut out the pieces in the *C's* at *r* and *s*, and smooth the openings. Next procure 2 pairs of suitable hinges and fasten one pair on each of the *A's* which have not the caster holes. Place the hinges on the face shown in the cut. When this is done, varnish or stain all the pieces thoroughly.

When the stain has dried, the pieces are ready to assemble. Take 4 of the *C's* and 4 of the *A's* and glue firmly; a few fine nails may be used, care being taken that the wood does not split. Then assemble the 2 *B's* and the remaining *C's*. When glue has set, put up the frame, put in the castors and stain or varnish again. When this is dry, a suitable cloth may be attached to this frame. This screen is cheaply made and if carefully built will serve the purpose of an expensive screen. One thing in which care must be taken



Construction details of mission screen



A mission screen easy to make

is the hinges, which must be on opposite sides, so that the screen when open must form a Z.

Seam Ripper from Old Safety Blade

A HANDY device for the housewife may be made from a safety razor blade. Cut a wooden handle 5 inches long. Bore holes to conform to the holes in the blade. Two screws, passed through the blade and the wooden handle will hold the blade firmly. This device will be found exceedingly useful to rip the seams in cloth while sewing

To Open a Molasses Jar

TO remove the top of a honey or molasses can which sticks, the following will be found practical: Take a piece of stiff wire and bend it into a circle the size of the top. Put this around the top, and with pincers, twist till tight.

A Simple Ruby Light

IF a 220-volt carbon lamp of 32 candle-power is used in place of the ordinary 110-volt lamp, a dim ruby light will be obtained which will not injure negatives exposed to it in the dark-room.

A Combined Ice House and Cold Storage Room

AN arrangement of a cold storage room for keeping milk, butter, eggs, fresh meats and small fruits in combination with an ice-house seems to meet the requirements of many country houses. Where perishable articles are purchased or obtained elsewhere in quantities, there is felt a need for some cold storage place other than the ordinary ice-box, which after all, is intended chiefly for articles in use from day to day and is rarely of sufficient size to accommodate large quantities of food.

The ice-house must necessarily be filled in winter, and the trick of using the chilled air from the ice-chamber to keep a storage-room below cool through the summer is an economical one, for there is no great waste of ice. Ice is a cheap commodity in winter, but rather an expensive luxury in summer. Its waste in hot weather in taking it from the ice-house to the kitchen almost daily represents about thirty per cent of the whole harvest. The daily opening of the ice-house, which admits warm air, causes a rapid shrinkage of the supply.

The combination ice-house and cold-storage room eliminates, to a certain extent, this daily waste. Most of the articles kept in the kitchen ice-box can be retained in the cold-storage room until actually needed. Consequently, there is less transportation of ice to the house than by the old method.

So far as possible this combination house should be located as near the back of the kitchen as conditions will permit, for if made easy of access, it will be utilized to its full extent both summer and winter. As the storage-house is a few feet underground, easy steps must be built to reach it, and not steep, narrow or awkward steps. The ice compartment of the house is filled at the back so that as little muss as possible is created either in putting in or taking out ice.

The cost of building a combination ice-house and cold-storage room is one-third to one-half greater than that for a simple, old-fashioned ice-house, but in the end the extra investment is well paid for both in the convenience and greater saving of ice. There is another saving that is even more important. Many people living in country houses could reduce the cost of living by buying perishable articles in wholesale quantities, but through lack of proper storage facilities they cannot do so. Butter purchased by the tub or firkin in the season when prices are the lowest would alone represent a big saving. Meats can also be made a big item of saving by buying in quantities, not to speak of small fruits in their season.

With an ample cold-storage room, such as that illustrated, one could buy nearly all perishable articles by the wholesale and be sure not to waste any through deterioration. The saving in this way alone would more than pay for the extra cost in one year.

The foundation of the combination house may be built of rough stones up to the ground level, cemented firmly together, and lined on the inside with a coating of good concrete. All parts of the house below the grade should be waterproofed in order to keep the moisture out. This is very important, for it is quite essential that the storage room should be dry as well as cold.

In the center of the cold-storage room there should be an iron or wooden pillar to support the load of ice overhead. Likewise, the floor girders above should be extra heavy to support the tons of ice. The outside walls of the ice-house can be built of brick or stone, or even of wood, according to the style of the house with which it is connected. If wood is used the upright supporting-beams must be extra heavy—four by six at least—so that they will be strong enough to carry the load of ice. Ordinarily, the ice is carried on the ground, and the construction of the ice-house may be made

very light, but in this case the ice is above, and the load is considerable.

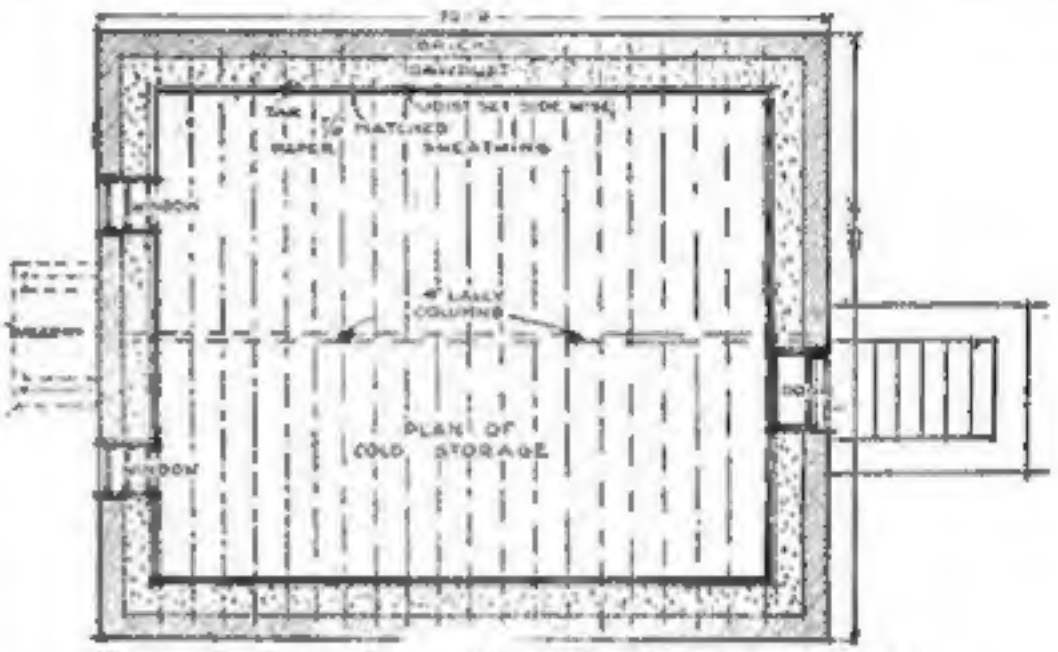
Another point that requires special emphasis is the necessity of building a water-tight flooring for the ice above. Otherwise the water dripping from the ice will leak through the ceiling and spoil the storage room. Also the ice must not rest directly on this flooring; otherwise heavy cakes when put in will destroy the waterproof lining. A platform is made of unmatched boards, supported on short joists laid on edge and nailed rigid with strips of wood. This platform should be strong and steady, but it must be arranged so that one can get under it easily when the ice is out. It will be necessary every autumn before putting in a fresh crop of ice, to clean the space underneath, examine the drainage-pipe, and look for leaks in the waterproof floor.

A good method to make this floor of the ice compartment watertight is to lay down rubber sheeting, and then nail zinc sheets down over it. The rubber strips make the joints watertight. The flooring must have a gradual slope toward the drainage pipe, which should be at one or more corners of the building. The laying of this waterproof flooring, and the installation of the drainage pipe are the most technical parts of the construction, for on their success depends the serviceableness of the storage room.

There is no sawdust or inclosed air space between the ice-chamber and the top of the storage room. This permits the chill from the ice to penetrate downward and keep the room below cold.

As the lower part of the room is underground there will be little chance for the temperature to rise in summer. The bottom and sides of the storage room, on the other hand, are well insulated either with sawdust or air spaces. One can take his choice in regard to filling the air spaces. Some find spaces of dead air between the walls just as satisfactory as layers of sawdust or any other filling. That is merely a matter of individual choice, although most of the big commercial ice companies still stick to the sawdust filling as the most satisfactory method of insulation.

Your storage room is thus inclosed on all four sides, and at the bottom with double walls either filled with sawdust or dead air, and with an uninsulated ceiling above. The chilling of the room from above is satisfactory, for the hot air naturally ascends, and the cold air descends. Of course, this produces a certain amount of waste



Ground plan of combined ice-house and cold storage plant

in the ice, but far less than one would imagine. When the room is once chilled the change in temperature is very slight. Little or no warm air can come up from the ground or through the sides, except through the window and the door.

To make the storage room serviceable it needs at least one or two windows on the side opposite the door, but these windows are double and have two sashes, which can be darkened at will with heavy shades. Between the double windows there is a dead air space, which forms a pretty good insulation against the outside air. The window can be opened on cold days just enough to get ventilation. Further ventilation is obtained by tubes that run through the walls on opposite sides. These ventilating pipes should be of a kind that can be closed from the inside at will, so that too much air may not be admitted.

This can be arranged very easily by having a cover to fit in the mouth

of each pipe, so that it can be removed and easily cleansed at any time.

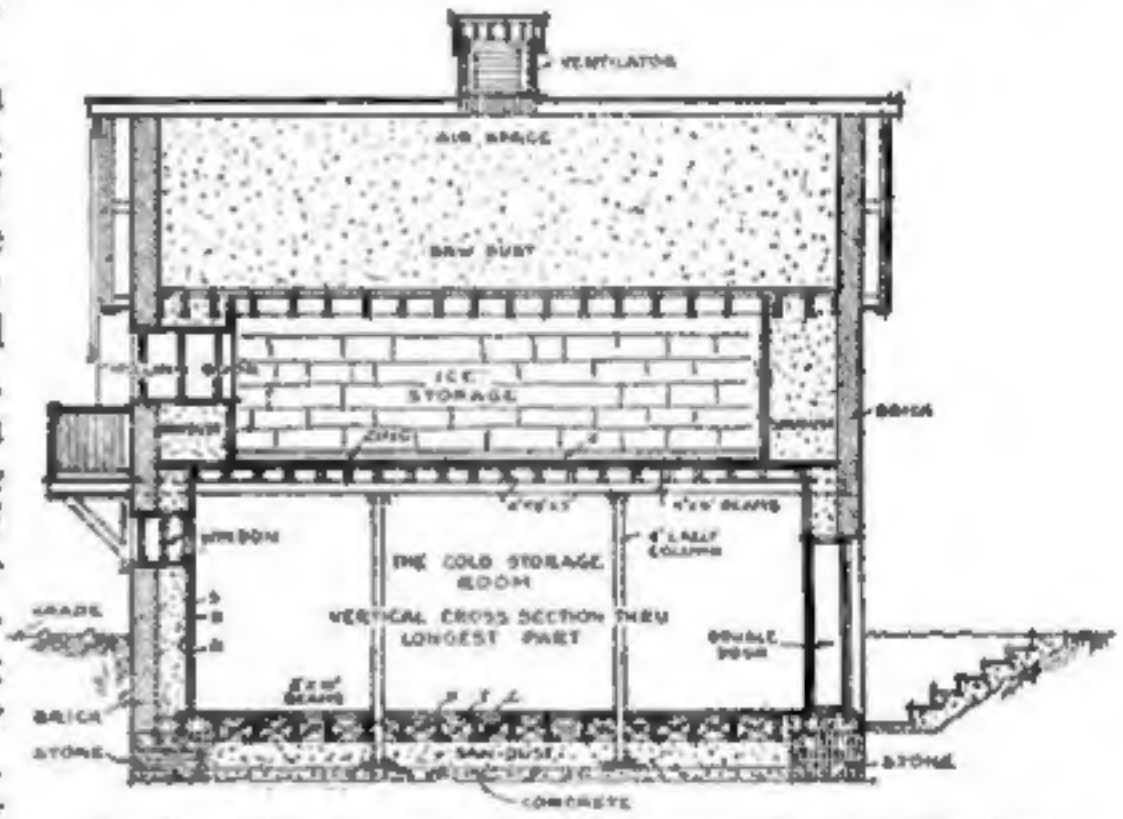
The entrance is through a double door. This is better arranged with an outside door opening outward and the inner door opening inward. A vestibule of a few feet between these doors is a great convenience and very economical. On a very warm day in summer one can then enter the vestibule and close the door behind him before opening the inside one. There is then no rush of hot air from the outside to raise the temperature of the room, an important consideration where one must enter the storage room several times a day. The mere admission of a current of warm air on a hot day may raise the temperature of the room several degrees, and cause the melting of a ton of ice in the course of the season.

The compartment above, in which the ice is stored is not very different from the inside of the ordinary ice-house. The ice must be packed economically and in regular layer fashion, and then covered with saw dust. There should be a ventilator in the roof. This is essential to the preservation and sweetness of the ice below. The filling door should be placed as high up under the eaves as possible, but not so high that there is no room for a block and tackle arrangement. This will facilitiate the handling of the ice enormously, and almost save the cost of one man in filling it.

With the house once constructed it is merely a matter of individual taste in dividing the storage room into compartments for keeping milk, butter, eggs, meats and small fruits. Any convenience of tables, shelves and bins that suggests itself can be installed later. The floor of this storage room is of cement, so that the spilling of any liquids will not cause damage. To keep the floor clean and sweet an occasional flushing with a hose will suffice. The drain for it should be at one side to permit the water to pass off quickly. But as a rule the room should be kept as dry as possible, since flushing the floor with water may cause an excess of dampness that will take days to evaporate.

The economy and convenience of such a combination house can readily be seen from the illustration. Ice for the house can be taken out from the back in the ordinary way, and that remaining in the compartment will be utilized at all hours for chilling the storage room below. There will be a little waste through melting in hot weather, but not to any extent. To offset this an extra ton of ice should be placed in the compartment each winter, and then the supply will last through the summer.

A combination ice and storage house of this character can be built from



Section of ice-house and cold storage plant, indicating construction of floors and walls

$500 upward, depending upon the size, cost of materials and of labor. A good size is 25′ square, outside measurements, which will give a storage room of at least 20′. If properly built and filled with ice, a temperature of 34° can be maintained in winter, and from 35° to 36° in summer, which is suitable for the preservation of practically all food products.

DRY batteries can be brought back to their electrical life for a time by punching holes in the zinc covering after having removed the cardboard filler, and soaking them in warm salt water.

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Forts on Rails to Travel Along Our Defenseless Coasts

A New York inventor, Lawrence Luellen, proposes the mounting of heavy guns on rails, to be run between concrete emplacements at suitable points. General Crozier, the foremost ordnance expert of the United States Army, has thought well enough of the proposal to sketch mountings for the guns. The guns can be quickly mobilized and used wherever an attack is threatened or actually begun. Any desired number of guns can be concentrated at a single spot—something which is not possible with permanent fortifications